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[OFFICIAL NOTICE.]

Twenty-eighth Annual Meeting, American Gas Light Association.

GENERAL ANNOUNCEMENT.

OFFICE OF THE SECRETARY,
NEW YORK, Sept. 13, 1900.

There will be an annual meeting of the American Gas Light Association held at Denver, Col., October 17th to 23d, 1900.

The meeting will be called to order by the President, Mr. George G. Ramsdell, of Philadelphia, Pa., at 10 A.M., on Wednesday, October 17th. The meeting hall will be in the Ordinary of the Brown Palace Hotel. The headquarters will be at the Brown Palace Hotel, Denver, Col.

The most satisfactory quarters are always obtained by writing in advance to the hotel people, and in doing so a reply should be requested, for which a self-addressed, stamped envelope should be enclosed, as misunderstandings may thereby be averted.

The Brown Palace Hotel is conducted on the American and European plans, and rates for rooms will be as follows:

American Plan.—Rooms without bath occupied by one person, from $3 to $5 per day; occupied by two persons, from $6 to $9 per day. Rooms with bath occupied by one person, from $4 to $6 per day; occupied by two persons, from $8 to $10 per day.

European Plan.—Rooms without bath occupied by one person, from $1.50 to $4 per day; occupied by two persons, from $2.50 to $5 per day. Rooms with bath occupied by one person, from $2.50 to $6 per day; occupied by two persons, from $4 to $8 per day.

Other hotels at Denver are the St. James and the Albany, rates at each of which are from $1.50 to $4 per day (American and European plan).

The Roll Call will be made by means of the door card system. Each member upon entering the hall for the first time will at the door receive a special card upon which he will find his name, address, etc., as these appear on the Secretary's books, and such card should be corrected and given to the doorkeeper. Members in attendance should attend to this very carefully, as these cards are used immediately after the meeting for correcting the annual membership list. Visitors will please hand to the doorkeeper their personal cards.

A blank form of application for membership accompanies this circular. More can be obtained of the Secretary. Remember, all applications must be in the Secretary's hands by October 7th, at the very latest, otherwise they will not be acted upon at this meeting.

The list of papers to be read at the meeting is as follows:

"The Use of Cards for Records and Accounts," by Mr. Wm. C. Anderson, Norristown, Pa.

"Inclined Retorts," by Mr. A. H. Barret, Louisville, Ky.

"Gas Advertising," by Mr. C. R. Collins, Seattle, Wash.

"The Uses of Gas for Manufacturing Purposes," by Mr. Jas. H. Walker, Milwaukee, Wis.

"Municipal Control of the Price of Gas," by Mr. Alfred E. Forstall, Montclair, N. J.

If the papers are of a sufficiently high standard the Beal Medal will be awarded to the author of the best paper presented; the question of which is best to be decided by the proper committee.

A lecture will be delivered to the Association, by Dr. E. G. Love, of New York city, upon "The Theory of the Incandescent Gas Light."

In addition to the papers and lecture the report of the Research Committee will deal with the question of the Edgerton Standard referred to the Committee at the last meeting, and with the other subjects that should give rise to a good discussion.

During the days of the meeting all the announcements will be posted on the bulletin boards in the hotel. All members are warned to take notice thereof accordingly.

All members attending the meeting are particularly requested to wear their membership badges in plain sight, thereby greatly aiding the officers and the local committee in their work, by affording a ready means of recognition.

In order that the "Year Book" containing the report of this meeting may be published and issued to the members immediately after the meeting, notice is hereby given that, if any of the speakers at this meeting desire to correct their remarks before they are printed, they will be given an opportunity before leaving Denver, Col., but not after. The stenographer will have typewritten copy of the principal discussions prepared at the headquarters between the sessions of the meeting, and all those who desire to correct their remarks must notify the Secretary at the close of the session at which such remarks are made, as all the

reports will be turned in to the printer immediately after the adjournment of the meeting.

Special rates for transportation have been granted (viz., full fare going and one-third fare returning by the same route), by the several Passenger Associations named and under the conditions noted:

The Trunk Line Passenger Committee, covering territory west of New England and east of Niagara Falls, Buffalo and Salamanca, N. Y.; Pittsburg, Pa.; Bellaire, Ohio; Wheeling, Parkersburg and Charleston, W. Va.

The New England Passenger Association, covering nearly all of the lines in the New England States.

The Central Passenger Association, covering the territory bounded on the east by Pittsburg, Salamanca, Buffalo and Toronto; on the north by the line of and including points on the Grand Trunk Railway from Toronto to Port Huron, thence via Lakes Huron and Michigan to the north line of Cook county, Illinois; on the west by the west line of Cook county and the Illinois and Mississippi rivers, to Cairo, including Burlington, Keokuk, Quincy, Hannibal and St. Louis; and on the south by the Ohio river, including points on either side of that river.

The Southeastern Passenger Association, covering the territory south and west of the Virginias, and south and east of the Ohio and Mississippi rivers.

The Western Passenger Association, covering the territory west of, and not including Chicago, Peoria and St. Louis; in other words, the territory west of that of the Central Association.

[The Secretary here explains at length the conditions necessary to obtain from the Passenger Associations the fare and one-third for the round trip. While the conditions governing this rate for travel are pretty well known, in that they differ in no wise practically from those that ruled heretofore, it is well to keep prominently in mind the fact that the reduction is conditional on there being an attendance at the meeting of not less than 100 persons holding certificates.]

SPECIAL.

As planned at present, the entertainment portion of the programme includes an informal reception at the headquarters—the Brown Palace Hotel—on Thursday evening, and a trip to Colorado Springs and vicinity on Friday and Saturday. This trip is outlined as follows:

Leave Denver Friday morning, reaching Colorado Springs at noon, take lunch at the Alta Vista Hotel, then take carriages for a drive through the Garden of the Gods to Manitou, and up Ute Pass or Engleman's Canon to the Cliff House, where the night will be spent. Music will be provided in the evening and dancing can be arranged for, if desired. The next morning a drive will be taken to Cheyenne Canon and Broadmore, returning to Colorado Springs at noon for lunch at the Alta Vista, and return to Denver in time for the evening trains. The cost of tickets, entitling the holder to hotel accommodations, lunches and seat in carriage for the drives during the trip, will be $5 per ticket. The railroad fare for the round trip between Denver and Colorado Springs will be $2. The total cost of the trip will thus be $7.

Members who have not replied to the letter of August 16th, and indicated their intention in regard to attendance at the meeting, traveling by the special train and participation in the entertainment outlined, will please send in at once, properly filled out, the postal cards sent out with that letter. This is necessary to enable the Committee of Arrangements to proceed with their work.

Be sure to obtain a railroad certificate when buying your ticket for Denver. The greater the number of certificates handed in, the easier it is to get the reduction in rates for future meetings, since the railroad officials count the certificates turned in as marking the full attendance. In our case the number of certificates is from 50 to 100 less than that of the persons in attendance, and our requests for lower rates are not given the consideration they should receive. Could we have shown certificates equal to the full attendance at Niagara Falls and New York we could probably have obtained a rate of one fare plus $2 for the round trip to Denver.

Apply for ticket and certificate at least 30 minutes before train time. Each person must sign his own certificate *at time of purchasing* tickets for Denver, Col. Be sure to hand the Secretary your certificate as soon as you reach the headquarters. Apply for return ticket at least 30 minutes before train time, and have your certificates with you.

All persons, ladies included, attending the meeting are entitled to the reduced rate from the territories named.

Members will please hand their certificates to the Secretary, or his clerk, upon arrival at place of meeting. If there are 100 members present holding certificates each certificate will then be properly endorsed and handed back to the owner before adjournment.

Members having questions which they desire to put into the Question Box should send the same to the Secretary as soon as possible, in order to give him an opportunity to have them printed and distributed to the members before the meeting so as to secure for them careful attention.

Keep this circular in your pocket, and apply to it if you are in doubt.

ALFRED E. FORSTALL, Secretary.

BRIEFLY TOLD.

THE GALVESTON SITUATION.—Last week, at the last moment, we were, through the attention of Mr. B. E. Chollar, of St. Louis, enabled to give some mention of the extent and nature of the damages to the Galveston (Texas) Gas Company, caused by the recent fearful storm of wind and tide that all but obliterated the only seaport city of the largest State in the Union. Since that mention we have, under date of the 13th inst., received direct word from Superintendent John Gimper, of the Galveston Gas Company, which confirms Mr. Chollar's telegraphic advices. Perhaps it would be best to let Superintendent Gimper's words tell the story. Here they are:

GALVESTON, TEXAS, Sept. 13, 1900.

Dear JOURNAL: The great calamity that beset our city is known to you. The loss of life and property is fearful. We lost all our holders (4 in number), the retort house is down; but, strange to say, the benches are in fairly good condition, as is the balance of the manufacturing machinery. The governor house, the coal sheds and the general warehouses were completely washed away. This you might well understand when I say that our yard was for quite a while under a flow of from 4 to 5 feet of salt water. Our street mains are full of Gulf water, from all sorts of broken pipes.—Yours truly, JOHN GIMPER.

We have listened to and spoken with several parties who have seen something of the situation of Galveston since its combat or conflict with the elements of water and wind, and their speech was such as to cause the thought that it is little short of miraculous that a bit of the famous Texas Island exists. However, there is no misery that cannot be overcome; and it is our satisfaction to be able to say that the Galveston Gas Company proposes to continue in business, for within a fortnight it will be asking for proposals for the reconstruction of its plant. When it asks for the figures we hope that bidders will remember the existing circumstances, paying due heed in their estimating to the fact that long credit must follow the rehabilitation. In the midst of its trouble, though, there is some cause for current congratulation, which latter is found in the fact that the Company did not lose a man.

THE INTERNATIONAL GAS CONGRESS.—We hoped with this number to be able to give some account of the International Gas Congress convened at the Paris Exposition, the first week in September, but whether the blame for our failure to have the story is to be attributed to our correspondent or to the mails, we cannot now truthfully say. The current number of the *Journal of Gas Lighting* to hand (it is dated the 11th inst.) declares that the Congress was an unqualified success, and that may be taken for granted as meaning that the assemblage was beyond the hopes of its conveners, seeing that the *Journal of Gas Lighting* did not have much to do with its convocation or direction. The United States representation, viewed either from the point of personal representation, or from the quality of the technical matter submitted to the Congress on behalf of the States, was a most potent factor in the success of the assemblage. Apart from the technical side of the Congress, however, that which was accomplished there on social account will, beyond the possibility of a doubt, bear golden returns to the gas men of every nation. The reception accorded the fraternity by M. Vautier and his colleagues of the Association of French Gas Managers, to their visitors and guests obliges one to add a fourth word to the famous motto of "Liberty, equality, fraternity." The additional word is hospitality. M. Vautier and his colleagues were unremitting and successful in their efforts to please and entertain the polyglot lot to whom they had to listen. Our own people were quite prominent in the proceedings, and, with that delicacy of tact which always marks the Frenchman in his intercourse with those of other nations, M. Vautier saw to it that the Director's Chair, during the carrying on of the technical proceedings, was occupied by a representative of the country that contributed the paper that was under consideration. This leads to the remark that the States' contributions to the paper list which attracted the most attention were those, respectively, by Mr. Fred. S. Shelton, of Philadelphia, and Mr. A. E. Forstall, of New York. At the time of the reading of the Shelton paper Mr. George G. Ramsdell, President of the American Gas Light Association occupied the Chair, and "our own" Mr. William McDonald, representing the Western Gas Association, directed the proceedings when the paper by Mr. Forstall was read. However, we will here have to conclude this mention of the Congress, when, if the JOURNAL's correspondent's matter does not turn to hand, we will have to republish the excellent resume of the proceedings contained in the *Journal of Gas Lighting* for the 11th inst. The Congress was undoubtedly a far greater success than those who planned it thought it would be.

The History, Character and Results of the Educational Work Carried on by the Trustees of the American Gas Educational Fund.

[A paper prepared by MR. ALFRED E. FORSTALL, and read at the International Congress of Gas Engineers, Paris, France, September 3, 4 and 5.]

The idea which finally resulted in the formation of the Gas Educational Fund originated in the mind of Mr. Walton Clark, and was brought to the attention of the American Gas Light Association, in the presidential address delivered by him at the meeting of the Association held in 1895. In this address Mr. Clark stated that the chief function of the Association was educational, and was carried out principally through the medium of the formal papers and discussions forming the greater part of the programme of the annual meetings; but in addition to this education of the members themselves there was a need of "Giving systematic aid to the many boys, and men, who, without the advantage of advanced education, are struggling to fit themselves for positions of responsibility, while filling subordinate positions in our gas works," and in this direction the Association was doing nothing. He continued, "I respectfully submit that the Association is failing of its duty in this matter. There are no gas text books. As far as I am aware the only authority attempting the work of setting problems to tax the ingenuity of the gas student is the City and Guilds of London Institute. Its work while admirable is insufficient to meet the occasion. The field is broad, the work worthy the best effort of the Association. Its cost in money would be small. Its value to the industry and to the youth engaged in it may best be estimated by those of us who have worked our way up from the ditch, or the bench, without the advantage of a previously obtained education. I recommend to you a standing committee on education."

This recommendation was adopted. A Committee was appointed and the work was taken up by it under the active direction of Mr. Clark, who was made Chairman. The following extract, from a circular issued in February, 1896, gives the outline of the method by which it proposed to accomplish the work committed to it:

"It is proposed to form a class of men and youths occupying subordinate positions in gas works, or employed as superintendents of small gas works, to whom shall be mailed, at intervals to be determined later, problems in gas manufacturing and distribution, together with suggestions as to the sources of information to be examined in studying the questions involved.

"It is proposed to begin the work with but one grade of students, submitting problems and questions of the simplest character, and looking for the success attained to determine the future development of the plan.

"The Committee hopes that there will be enough of interest manifested to justify an extension of its work to the formation of classes of two grades and the awarding of certificates of excellency at the termination of a two years' course in either grade.

"It is not desired to include in the Class now to be formed students who have had the advantage of advanced or technical education or of considerable experience in the gas business. The work is intended to 'give systematic aid to the men and boys, who, without the advantage of an advanced education, are struggling to fit themselves for positions of responsibility while filling subordinate positions in gas works.' To stimulate their interest in the work certain appropriate and valuable prizes will be awarded for the first, second and third best answers to the examination questions submitted at a time to be determined by the Committee. The prizes will consist of books, drawing implements or chemical apparatus."

A Class was started along these lines, in March, 1896, with a membership of 76, which had been reduced to 44 by October, through the failure on the part of the other 32 to answer the questions sent out. The experience gained by the Committee in the actual working of its plan led it to report to the Association, at its meeting in October, as follows:

"The work up to this point has been experimental and preparatory. From the 1st of December next the regular work of the Class begins. It is proposed to send out four lists of questions a year, and to have these questions cover the entire range of the duties of the gas superintendent. The Committee believes that the good that can be obtained by a member of the Class from work in the Class is in but small part the privilege of receiving the answers to the questions. The greater good must come from the familiarity with the books and from the mental training that he will get from working up his answers. With many of the Class the greatest good of all will probably be the clearing up of ideas that come from their exact expression in writing.

"The Committee referred in one of its circulars to the matter of prizes. After serious consideration it has come to the conclusion that it will be better to expend whatever money may be at its command in such work as will benefit all of the Class, rather than for the purchase of prizes which can benefit but few, and very possibly those who, all things considered, are less needful of assistance. Therefore, with your approval, the Committee will abandon the idea of giving prizes, and will expend such funds as may come in its possession for the purpose of circulating among the members such literature as it may be able to command and thinks will be of value to the Class."

Between December, 1896, and January, 1898, the work of the Committee was carried on with regularity, the number of members of the Class varying between 50 and 60. During this time five sets of questions were sent out. Practically all the work of preparing the questions and the correct answers to them, receiving, examining and commenting upon the answers of the students, and sending out the questions, answers and comments, was done by Mr. Clark, who, though he was already a very busy man, was willing to give to the work the time and attention it required of him personally even with the aid he received from his office force. But even he, though still intensely interested in advancing the welfare of the students and the Association, found himself unable to continue the work after January, 1898, and it was suspended, pending the result of an effort to organize it upon another footing that was being made by a Committee of the Council of the Association.

The task set for itself by this Committee was to secure from gas companies, individual members of the Association and other persons interested in, or connected with, the gas industry, subscriptions extending over a period of five years, and amounting to a sum sufficiently large to enable the payment of a salary that would compensate some competent person for devoting a large portion of his time to the work. The fund so raised was to be administered by a Board of Trustees, appointed in the first instance by the American Gas Light Association, but which after its appointment was to have the power of filling any vacancies that might occur in its membership. The President and the Junior past-President of the Association were, however, to be ex officio members of the Board. These Trustees were to have full power as to the selection of the person who should have charge of the work and the handling of the money subscribed to the fund.

The labor of the Committee was successful. It was able to report to the Council, at its meeting in October, 1898, that it had secured subscriptions pledging the payment for five years of a sum amounting to $3,193 per annum (this has since been increased to $4,170 per annum), and that this showing warranted it in recommending the immediate appointment of a Board of Trustees of five members, three of whom were to be permanent, and two ex officio members, as specified above. The Council endorsed the recommendations of the Committee, and so reported to the Association, which thereupon gave the final confirmation to the suggestions by appointing the Trustees and committing the work to their hands. It also voted a sum of $250 per annum, to be paid for five years from the general fund, as its subscription to the educational fund.

The Trustees so appointed effected an organization in January, 1899, under the name "Trustees Gas Educational Fund," and the educational work was resumed in February of the same year. This work is carried on by means of a Correspondence Class, membership in which is limited to those employees of gas companies who can secure the endorsement of their applications for admission by a member of the American Gas Light Association, or a subscriber to the fund. No tuition or any other fees are charged. The course of instruction has been made three years in length, the questions and problems set becoming more and more difficult from beginning to end of the course. A new section of the Class is formed each year, each section being given practically the same course. The method of instruction is as follows:

On the first day of January, for instance, a set of 12 questions is sent out to all the members of a section, each section receiving a different set of questions. Answers to these questions, in the preparation of which the student is at liberty to use any and all means of securing information of which he can avail himself, and is encouraged to consult the Secretary upon any points which he does not understand, or about which he can find no information, must be sent to the Secretary of the Trustees on or before March 1st. The Secretary, who is in charge of the work, examines each set of answers carefully and makes the necessary criticisms upon them in a personal letter to the student, which is mailed April 1st, together with what are considered by the Trustees to

be the correct answers to the questions and the next set of questions. Any general criticisms applying to the work of the section as a whole are embodied in circular letters. In this way four sets of questions are received and answered by the student each year, all the answers being commented upon by the Secretary.

All the students being, as stated, employees of gas companies, the work done in connection with the Class must of necessity be done outside of working hours, and it is, therefore, impossible for them to answer a set of questions in a shorter time than two months. Owing to the number in the Class it is also impossible for the Secretary to give the proper attention to the answers in less than a month's time, which limits the number of sets to one each three months.

The questions deal with practical subjects, and with those theoretical points a knowledge of which is necessary in order that the practical problems continually arising in gas works may be fully understood and correctly solved. It is of course impossible to cover with 144 questions all the subjects upon which a gas engineer should be informed, but it is hoped that the effect of the three years' work will be to form, in the case of each student, a habit of study, which, with the knowledge of where and how to find information already obtained, will lead and at the same time enable him to continue by himself the work begun in the Class. Special attention being paid to the exact expression by the student of the idea sought to be conveyed, the training in this direction must also be of great value. In fact, as is stated in the portion of the first report of the Committee on Education previously quoted, the mental training acquired will undoubtedly be of much greater value than the actual knowledge obtained from the answers to the questions, though it is hoped that these will form, in time, a valuable catechism for use by the student in gas engineering. There is appended to this paper a full set of the questions and answers sent out to the Class since the work has been taken up by the Trustees.

There being no inducement for membership in the shape of prizes or the element of competition, and as membership cannot be maintained unless the student is willing to devote no small amount of his leisure time to work, it is safe to assume that the great majority, if not all, of the members of the Class possess an earnest desire to increase their knowledge of the business in which they are engaged. The fact that since its inception the number in the Class has never fallen below 40, and that since the organization of the Trustees it has averaged 100, shows that this desire for increased knowledge is widespread among the employees of gas companies. The extent of this eagerness to learn and the value placed by the students upon the means afforded to gratify it, as shown by the painstaking labor devoted to the work, have surprised even those with whom the idea at first originated. Instruction given by correspondence is necessarily more difficult to impart and at best less complete than instruction given by an instructor in personal contact with his pupils, but it is the only possible method of supplying the demand, when as in this case the hundred members of the Class are scattered over an area of some 2,000,000 square miles.

It would also be better if the money at the disposal of the Trustees would permit the employment of more than one instructor, since more time could then be devoted to a study of the needs of each student and the efficiency of the work correspondingly increased. But even as it is the work of the Trustees has proved of great value, as is shown by the record of the section of the Class which completed its course January 1st, 1900, and as this value is recognized the size of the educational fund will increase and still better results will be obtained.

We have so far dealt only with the advantages conferred by the Class upon the students, and it may be thought by some that the gas companies which subscribe to the educational fund are philanthropically spending money for which no return is to be received. It is, however, hardly necessary at this day to enter into any elaborate argument to prove that anything that increases the efficiency of the workers in any industry must of necessity prove of immediate and great value to the industry itself, and that, therefore, anything that helps to increase the amount of knowledge of the art of gas making possessed by the foremen and superintendents of gas works and by the subordinates from whose ranks future foremen and superintendents must be drawn, cannot fail to return to gas companies increased profits many times greater than the small amounts required from each company to afford sufficient revenue to carry on the educational work in the most efficient manner. The more extended recognition of this truth will doubtless lead to a continual increase in the interest taken by the companies in the work of the Trustees and to a corresponding increase in the amount of money at their disposal.

Although his knowledge of what is being done in other countries is necessarily incomplete, the writer is under the impression that the Class carried on as described in this paper affords the only instance of organized effort to help and direct students of gas manufacture in their endeavors to acquire the increased knowledge necessary for their advancement in their chosen profession without compelling them to leave their work and gather at some one place to receive the desired instruction. Such a course as that given at Carlsruhe, or by the German Continental Gas Company at Dessau, does not provide for the great majority of the employees of gas companies, who, though anxious to learn, must acquire their education as best they can in the leisure time at their disposal outside of working hours. It is the need of these men that the Trustees of the Gas Educational Fund are endeavoring to supply by the Practical Class, with a success that is already encouraging, but the true extent of which time alone can reveal. Is not the example worthy the study of all associations of gas men with a view to its possible improvement and adoption?

Origin and Growth of the Grand Rapids (Mich.) Gas Light Company.

Mr. Paul Doty, in a recent issue of the *Michigan Tradesman*, writes thus entertainingly of the history and growth of the business of the Grand Rapids Gas Light Company, of which corporation he is the efficient Secretary and General Manager:

The approaching semi-centennial of the incorporation of the city of Grand Rapids is happily an opportune time for a review of the industrial growth of the city, and the *Tradesman* is to be congratulated on the occasion of its splendid special issue, embodying somewhat of the history of the progress of those industries which have added to the fair fame of Grand Rapids as a city.

It is with pleasure, and with personal appreciation of the opportunity presented, that I write of the history and growth of the Grand Rapids Gas Light Company, aptly quoted, "The model corporation of the city," and one of which the citizens speak as "our Company," rather than by its corporate name.

The Gas Company was born in 1857, but a few years after the incorporation of the city itself, and has steadily gone onward and upward, even as the city itself has taken no step backward. In this day the founding of a gas company appears a small task in comparison with the courage of their convictions required by the founders of the Grand Rapids Gas Light Company. To-day the industrial uses of gas are so well understood and the value of gas so well appreciated that it enters into the household and business life of nearly every citizen, and great would be the loss if for any reason an interruption should come to the supply of gas. In 1857, the use of gas was but little known and the cost was so comparatively high—$4 per 1,000 cubic feet—that prospective profits were truly uncertain, and it is a matter of record that dividends were not paid for several years. Grand Rapids had in 1857 a population of less than 8,000, and of this number but 37 were enrolled as customers of the Company when gas was first supplied, on November 14, 1857.

From 1857 to 1883, when the *Tradesman* was born, the Gas Company prospered with the growing wealth and importance of the city. The population had increased to above 40,000 and of this number 1,602 were then customers of the Company. The price of gas had steadily decreased until the $2 mark had been reached. Sales per capita were then 1,000 cubic feet per annum, and but 4 per cent. of the people were supplied. Gas manufactured from coal was then distributed exclusively, and the cost of gas coal was about $4 per net ton delivered in Grand Rapids. To-day, with a city of 100,000 people, the Company supplies over 10,000 customers, or more than 10 per cent. of the population, and the sales per capita per annum exceed 3,000 cubic feet, and the dollar mark has been reached in the price of gas. This, too, notwithstanding the cost of gas coal is but slightly reduced—the price to-day being about $3.30 per net ton delivered.

The past 17 years have witnessed important advances in the gas industry, and the spur of electric competition can fairly claim no small part of the credit. In 1883 the gas industry was devoted almost exclusively to the lighting interests; to-day this field is divided with the electric industry, but gas has expanded into the heating and cooking and power fields, so that the use of gas per capita has trebled, notwithstanding the division with electricity of the lighting business. To-day gas engineers hold that gas is a form of energy, and as such can be converted into light, heat and power, and with these three applications of usefulness there is no fear of the stability of the industry.

A review of the gas business divides itself naturally into the manufacture, the distribution and the management, and along these lines I

will briefly indicate the important changes: In 1883 the manufacture of gas was exclusively from gas coal, and the works were located on Ottawa street, near the G. R. & I. crossing. This was the site of the first works, built in 1857, and continued to serve until 1886, when the growth of the business required the erection of works of much increased capacity, at the corner of Wealthy and Oakland avenues, the site of the works to-day. In 1890 the manufacture of carburetted water gas was undertaken and the superior light giving qualities of this new gas were soon apparent. With carburetted water gas as an illuminant, even with the now old-fashioned open flame burners, the Company was more than able to hold its own against the advancing use of electric light. Minor changes have been made at various times, all tending to increase the capacity of the works and to add standard apparatus only for the manufacture, purification and storage of gas, until the works stand to-day fully equipped for the best results. In 1897 was undertaken the erection of the new gasholder of one million cubic feet capacity, the largest gasholder in the State, and a conspicuous landmark of the city.

The erection of gas works apparatus can to-day be undertaken with little risk of becoming obsolete before having become worn out or destroyed. The type of gas machinery is generally standard and the design uniform. This adds much to the safety of the investment.

It is in the distribution and utilization of gas that we find the greatest progress in the 17 years now passed. Since 1883 we have the gas stoves for heating and for cooking, the famous Welsbach mantle for incandescent gas lighting and the superior gas engine for all power purposes. In 1883 gas for fuel was almost unknown. The stoves were of poor and inefficient design, and the cost of gas was so high that the introduction or use of fuel appliances was scarcely undertaken. To-day, with stoves of standard efficient design and with the price of gas so low, there are more than 7,000 cooking and 3,000 heating appli ances in use in our city, and wherever the mains of the Company extend it can safely be said that everybody who is anybody uses gas for fuel. So important a part of the Company's business has the appliance department become, that a special store is maintained for the convenience of the Company's patrons, and that it is appreciated by the public is evidenced by the growing patronage. The Company's offices in the Ledyard block, at the corner of Ottawa and Pearl streets, are conspicuously attractive, and a cordial invitation is extended to the public to take advantage of the conveniences of the office.

The Welsbach mantle has revolutionized gas lighting. This invention, now in so general use, employs gas to raise a mantle of the oxides of rare earths, notably thorium, to incandescence with a light of superior brilliancy. In 1883 the open burner, then in general use, gave a light of 16 candles, when using gas at the rate of 5 cubic feet per hour, or the lighting efficiency was but little more than 3 candles per cubic foot.

The Welsbach burner uses but 3 cubic feet of gas per hour and, with the new "Yusea" mantle, gives a light equal to 100 candles, or the lighting efficiency is more than 30 candles per cubic foot of gas. Here, then, is one of the greatest steps forward—a gain of a tenfold efficiency. How poor the 16-candle power light looks when compared with the new incandescent gas light, and how great the saving to the public! Since 1883 the price of gas has been cut in two, but the quality and intensity of light have been increased tenfold. Is not this statement a sufficient proof of the public utility and benefaction of the gas industry?

The application of gas for power purposes is of recent growth. In 1883 the gas engine was but a toy, expensive in first cost and built for very small users. To day gas engines are in use in Pittsburgh of more than 600 horse power, and in Europe installations of 1,000 horse power are recorded. In Grand Rapids there are several engines as large as 35 horse power, and many of lesser size, down to the small one and two horse power motors used for printing presses, meat choppers, ice cream freezers, etc. Gas engines are used not only for power purposes, but for driving dynamos which, in turn, make electric light at a corresponding saving of cost of electric current to large consumers. The Gas Company itself has for exhibition purposes a gas engine and dynamo, in its office windows, and each night its sign "Gas-Electric Light" shines forth brightly with incandescent electric lights to demonstrate practically how gas may furnish electric light. It is the opinion of several famous engineers—notably George Westinghouse, of Pittsburgh—that gas for motive power will largely supplant steam, the thermal efficiency of the gas engine being so far in advance of the steam engine that it will be unprofitable to employ the latter where gas can be obtained at moderate prices.

Nothing has been said of the attempted introduction of fuel gas in Grand Rapids in 1890. The affair here, as everywhere else it has been tried, was a total failure. Fuel gas has too many practical disadvantages to be a commercial success. The value of gas for light, heat and power depends upon the thermal or heat units contained, and it is essential that commercial gas should not fall below 650 to 700 heat units per cubic foot. The heating value standard to-day is quite as important and should be as well understood by the public as the old-fashioned rating of "16 candle power," a term now almost obsolete because of no practical application.

To write of the management of the Gas Company brings to mind the memory of the names of T. D. Gilbert and Thomas Smith. In 1883 these gentlemen were active in the management and responsible for the success of the Company. Mr. Smith died in 1889, and Mr. Gilbert in 1894. Upon the death of Mr. Gilbert the ownership of the Company was transferred to Emerson McMillin and his associates, and how well the trust imposed upon Mr. McMillin has been administered is evidenced by the stability of the Company to-day. Mr. McMillin's associates in the Board of Directors include N. L. Avery, Vice President; H. D. Walbridge, Second Vice-President; James M. Barnett, Anton G. Hodenpyl, Henry Idema, T. J. O'Brien, J. Boyd Pantlind and Lester J. Rindge, and it is generally conceded the people's interests are strongly conserved by so representative a gathering of gentlemen and that the security of the investment to the stockholders cannot be gainsaid. In 1898 the writer succeeded H. D. Walbridge as Secretary and General Manager of the Company, and H. B. Wales became Treasurer.

In 1899 the Board of Directors adopted a plan of direct profit sharing with the employees of the Company, by which the employees' investment of labor is made equal with the stockholders' investment of capital, so that the employees receive semi annually a dividend of 3 per cent. of the amount of their yearly wages. This just and generous plan of rewarding faithful and meritorious service on the part of the employees, it is believed, will solve the so-called labor problem, and the public is interested to the extent of receiving cheerful and prompt service satisfactorily rendered.

The Gas Company has ever been mindful of the interests of its patrons and has ever responded to the increasing demands of the growth of the city, and has extended its mains into new territory, to give to all the citizens the comfort and convenience of the use of gas. It has always been in the van of the cities of greater size in the matter of low priced gas, and has always responded to the many wants and needs of its patrons by courteous attention. It has not been wanting in public spirit and enterprise and has always believed public service is a public trust. The tangible result of all this is that the securities of the Company have attained a sure reputation for value and stability and, notwithstanding the competition of electricity or otherwise, has it not been shown there is faith for the hope that the Company will continue to maintain its deserved popularity?

Petroleum Industry of Canada.

[A paper prepared by MR. JOHN D. NOBLE, of Petrolia, Ontario, for the International Petroleum Congress, Paris.]

Very little is known abroad about the Canadian petroleum industry, for the reason that the Canadian home market absorbs all the products which are manufactured from Canadian crude oil, and the demand for home consumption is constantly increasing with the growth of the country, insomuch that the present production of crude oil from the wells, which is increasing every year, is only sufficient to supply two-thirds of the demand, and the other third has to be imported from the United States.

Oil has been discovered at Gaspe, in the eastern part of Canada, and geologists say that oil will yet be found on the banks of the Mackenzie river in the far northwest, but I will confine my remarks strictly to the district in which I reside, and where I have been engaged in the oil business for the last 34 years.

The principal oil producing region is situated in that most fertile peninsula known as the garden of Canada, lying between the great lakes Huron and Erie in the counties of Lambton, Kent, Middlesex and Essex, and the most prolific spot is the township of Enniskillen, in the county of Lambton and province of Ontario. In this township there are two pools, or oil producing districts. One is four miles wide by nine miles long, in the center of which, and in the center of the township, is the town of Petrolia, a place of about 5,000 inhabitants, nearly all of whom are engaged in the business of producing crude oil in this district. The second spot is at the village of Oil Springs, about seven miles from Petrolia in a southerly direction, where there are

about 2,000 oil wells. Oil has also been discovered in the townships of Plympton, Sarnia, Dawn and Euphemia, where there are about 1,000 oil wells, making in all about 10,000 wells producing oil in the county of Lambton. Oil is also being produced at Bothwell, Dutton and other places in the adjoining counties. This oil lies in a stratum of oil bearing rock about five to ten feet in thickness, most of which is at a depth of 460 feet from the surface in the Petrolia district. Some of it is found outside of Petrolia at 375 to 400 eet at Oil Springs, Dawn, Euphemia and Bothwell. The Canadian wells are all drilled by pole tools, and so expert have the workmen become in handling these tools that it only takes a contractor one week, working night and day, to put a well down to a depth of 475 feet from the surface, and the expense of drilling it is only $100. In case a good well is obtained the extra expense of drilling for plant to fit it up ready for pumping is $250 more, but this plant can be removed to another well in case the well proves to be unproductive, so that the actual loss in sinking a dry well is only $100. This, however, is a case of very rare occurrence in the Petrolia oil fields, as in this district a well is obtained every time sufficient to pay a very large interest on the capital invested.

Boring Plant.—The plant consists of 275 feet of iron casing 4½ inches in diameter, which is screwed together in 18 foot lengths and lowered into the hole to shut off the surface water and soapstone, also 465 feet of iron pump tubing, 1¼ inches in diameter, with a brass working barrel at the bottom of it, containing a ball valve. Inside of this pump tubing is 465 feet of iron sucker rods, ⅝ inch in diameter, to which is attached the upper ball valve and by means of which the oil is lifted from the bottom of the well and forced into a tank on the surface of the ground. A little salt water usually comes up with the oil and sinks at once to the bottom of the tank from which it is drawn off, leaving the oil ready for shipment. A number of wells are pumped into one tank, as about three wells are drilled on each acre of land. The oil is drawn away from these tanks by means of tank wagons containing 8 barrels each and delivered at different receiving stations, or it is forced to those stations through pipe lines.

A company called the Petrolia Crude Oil and Tanking Company has been in existence for many years, having a network of pipe lines extending to most of the producers' wells. This company receives the oil from the producers, and delivers it to the refiners at a small charge, or issues warehouse receipts for it deliverable on demand, and the producer can hold his oil in perfectly safe underground fireproof tanks and sell it whenever he wishes to do so.

System of Storage Tanks.—These underground tanks are circular in form and dug to any capacity required, the clay in the Canadian oil region being specially adapted for this purpose. There is 100 feet of tallow-waxy kind of blue clay to go through before the top rock is reached; a number of petrified cockle shells are found in this clay, which clay is perfectly impervious, and so compact that it will hold either oil or water when the hole is dug out without leaking a drop. Expert workmen trim down the walls with their spades until they become smooth and shining, and when the hole is dug out they commence at the bottom and ring it up to the top with solid wooden rings. These rings are formed of kants, which are pieces of Canadian pine lumber, cut in the form of the segment of a circle, and shaped just to fit the circular wall of the tank; they are from 3 to 4 feet long, according to the size of the tank, 5 inches wide, and 1 inch thick, and the joints are covered by the top piece as the workmen proceed to nail them together from the bottom and ring up the tank. This wooden lining is put in to prevent the possibility of any clay caving in. The tanks for holding crude oil are generally dug 30 feet in diameter and 60 feet deep, and hold about 8,000 barrels in bulk of 35 imperial gallons to the barrel. It is only after sinking down about 20 feet that this peculiar formation of tallow-waxy kind of blue clay is found, the first 20 feet being a rich alluvial deposit formed from the dropping of the leaves of the trees for a long period of years. The blue clay is taken from the bottom of the tank, and puddled about one foot thick behind the wooden curb for the first 20 feet, thus forming a perfect water tight tank, which is then covered by large timbers and 2 inch planks with a coating of gravel on top. Oil has been held in such tanks for ten years without leaking a drop, and there is no danger from lightning, which has caused so many disastrous fires from oil stored in large iron tanks.

The Canadian crude petroleum when pumped from the wells is of a dark green color, and the gravity is from 32° to 37° by the Beaume hydrometer, according to the locality to which it is pumped. It is worth at present $1.75 per barrel of 35 imperial gallons to the barrel, in bulk at the wells, and it costs 50 cents per barrel to produce.

There are no flowing wells in Canada; all the oil is produced by pumping. The crude oil when distilled contains 5 per cent. of benzine and 42 per cent of illuminating oil.

After the illuminating oil is taken off, the heavy vapors are blown out of the still by an injection of steam and condensed and sold for gas oil or liquid fuel, and the balance of the product left in the still is petroleum tar, which is very rich in paraffine, and from which a large percentage of wax is obtained for making candles. It is also manufactured into lubricating oils of the very finest quality, and the residue makes a very superior fuel, being rich in carbon.

The wells are 4½ inches in diameter and 475 feet deep. At a depth of 460 feet the oil-bearing rock is pierced, and at this point a nitro glycerine torpedo is exploded to shatter the rock and allow the oil more freely to flow into the well.

Pumping the Wells.—The wells are so close together, and so numerous and of such shallow depth that they can be pumped at a very small expense, one steam engine of 25 horse power being capable of pumping 200 wells. This is done by means of balance wheels and jerker rods attached to each well.

The engine pulls the first wheel horizontally backwards and forwards, which in its turn pulls the second wheel, and so on. The rods which pull the working beams at each well are attache to these wheels, an equal number on each side of the wheel, so that the weight on one set of pump rods on one side of the wheel going down in the pumps pulls up the other pump rods in the wells on the other side of the wheel, and all the engine has to do is to overcome the balance and the friction.

The manufacture and exportation of Canadian pole tools by the Oil Well Supply Company, of Petrolia, Canada, for drilling artesian wells, is an industry which is assuming large proportions, as the Canadian white ash is especially adapted for this purpose, and many drillers and skilled mechanics from Petrolia, Canada, have been sent with sets of these tools to all parts of the world to drill artesian wells, either for oil in Galicia, Sumatra and Borneo, or for water in Australia.

Drilling with Pole Tools.—A good Canadian drilling rig, with set of pole tools sufficient to drill a well 4½ inches in diameter and 500 feet deep, including engine and boiler, is worth about $2,000.

These poles are 36 feet long, each with a screw pin on one end and a screw socket on the other. They stand up in the derrick, and as fast as the drilling of the well proceeds they are screwed together and lowered down into the hole and attached to the drill, which is a heavy iron bar 36 feet long and 3½ inches in diameter, and shod at the bottom with steel, which is called the bit for cutting the rock. The driller stands or sits at the top of the well holding the poles in his hands, which are attached by a chain and swivel to the working beam, which is moved up and down by the steam engine, and the weight of the tool cuts the rock. The driller keeps turning the poles around all the time so as to make a round hole. When the bit gets dull the poles are raised by the steam engine and unscrewed and they stand up in the derrick; the bit is then removed from the bottom of the bar and another sharp bit screwed on. The cuttings are removed from the bottom of the hole by a hollow tube, which is lowered into the well with a valve opening inwards at the bottom. The weight of the tube with the poles attached forces all the cuttings into it through the valve, and when it is raised the weight of the cuttings closes the valve and they are all caught inside and raised to the top, and so on until the well is finished. The poles being 36 feet long each, the driller can easily tell how deep the well is by the number of poles he has on. There are short poles at the top to connect to the working beam.

Geological Formation.—The geological formation of the Petrolia oil region is corniferous limestone, underneath which a sand rock is found from 5 to 10 feet in thickness, filled with petroleum. The surface of the land is a very rich fertile clay suitable for farming; then comes 100 feet of blue clay, which is bored out with a large auger. It is so compact that this can easily be done in one day. A wooden octagonal conductor, 10 inches in diameter, is then lowered down to the top rock and the drilling commenced. Then comes 40 feet of top limestone rock, then 135 feet of soap stone, making 275 feet, which has to be cased off with iron casing 4½ inches in diameter; then comes 15 feet of middle limestone rock, then 40 feet of lower soapstone, then 130 feet of lower limestone rock, making 460 feet in all, at which point from 5 to 10 feet of oil bearing rock is struck in which a nitro-glycerine torpedo is exploded about 15 to 20 feet below this, so as to leave a pocket of 10 feet below the bottom of the oil bearing rock. Sometimes a very large body of salt water is struck below the oil bearing rock, which has to be shut off with a plug.

There is ample room for the further development of the Canadian petroleum industry. Already there has been about $20,000,000 of capital invested in the business in Ontario during the last 30 years, which has been principally provided by Canadian and American investors, but the demand for petroleum is increasing so fast that the introduction of much more capital is needed, not only to increase the production sufficiently to supply the demand for home consumption, but also to develop an export market for this product.

The oil bearing character of the district in the county of Lambton has long since become thoroughly known; it is an established industry, capable of great expansion, and, in consequence of the very small cost of drilling oil wells, and the average cost of production being so low in proportion to the selling price, the business is one that offers most remunerative returns to the capitalist. In relation to this particular Canadian oil field, the average cost of the crude oil delivered at the wells, it has been stated, does not exceed 50 cents per barrel. The average selling price during the last six months has been $1.72 a barrel. The report of Mr. Alfred R. C. Selwyn, C.M.G., F.R.S., Director of the Geological Survey of Canada, dated December 2, 1895, says that the supply of oil from this district will continue for a long and indefinite period of years.

The title in fee simple to the land in the Canadian oil region is perfect, as it is handed down from owner to owner directly from the Canadian Government to the proprietor. There is no royalty or claim of any kind on it.

In this oil region the farmers can be seen gathering luxuriant crops of wheat, oats, corn and hay from the surface of the ground, while the same fields are surrounded by a row of wells diligently pumping oil from a depth 460 feet below.

The Design of Steam Power Plants.—No. IV.[1]

By Mr. Henry C. Meyer, Jr., in *Engineering Record.*

The method of buying a steam engine most frequently employed by engineers is to invite bids from a number of builders upon an engine which, with a certain number of revolutions, steam pressure and back pressure, will develop a given horse power. The cylinder dimensions are usually supposed to be looked after sufficiently when the bidders are asked to state the steam consumption they will guarantee. On opening the bids thus obtained, it is sometimes found that some firms offer engines with much smaller cylinders than others, to do the same work. The prices are naturally different, and it occasionally happens that the purchaser does not get the engine best suited to his needs, first cost and economy of operation both being considered. The non-technical factory manager, knowing nothing of engines, frequently makes a mistake in this matter of purchasing an engine, as he does not know the type of engine he wants and much less what its details should be. He, therefore, frequently purchases something very different from what he needs. Such an individual should either engage a consulting engineer to invite bids for him on the type of engine best suited to the conditions, or go to one reputable engine builder, inform him of the conditions that exist, and have an engine built to suit them. There is no doubt but that there are builders fully competent to study the conditions involved and advise an owner what is required. Two or more builders should not, however, be placed in competition where the cheapest bid is likely to be the deciding factor in the selection of an engine, and an incompetent person is to be the judge of the propositions offered. It could hardly be possible to educate the non-technical purchaser of engines within the limits of this article, but there are a number of engineers who are not steam engineering experts that have to buy engines without the aid of expert advice; and it is hoped to give some general information and data to assist such in determining the type of engine, approximate cylinder dimensions, etc., best suited for different situations, so that bids can be invited upon a specific machine and the benefit of a competition secured, where all bids are made upon the same basis. In doing this, the selection of the type of engine will first be discussed; afterward, the determination of those factors that fix the capacity and efficiency of an engine; and finally, the method of applying these factors in the general equation for determining the power of an engine so that the cylinder sizes or volumes may be calculated.

Selection of Type.—To most people it is manifest that it would be bad engineering to install a costly triple expansion engine that operates with the highest economy in a plant where fuel is of little or no value. Many situations, however, require the keenest judgment to select the type of engine best adapted for the service it is to perform. There is a saying that any expenditure for plant is warranted that results in savings which more than pay the interest on the expenditure, the depreciation and the cost of repairs on the plant. This is a simple proposition in itself, but it is not always easy to predict the saving that will follow the installation of a machine, or what the depreciation and repairs will be. As a basis for such calculations regarding steam engines, Table I.

Table I.—*Steam Consumption of Different Types of Engines.*

Type of Engine.	Pounds of Steam per H.P. per Hr.	Steam Pressure Lbs. Gauge.
High speed simple	32	80–100
H.-S. comp. non-cond	24–26	150–110
H.-S. comp. cond	19–21	150–110
Corliss simple non-cond	26	80–100
Corliss simple cond	21	80–100
Corliss comp non-cond	20–22	150–110
Corliss comp. cond	14–15	150–125
Triple-expansion cond	13	150

is given, and in it is shown the steam consumption per horse power per hour which might be expected from various types of engines with different steam pressures. The figures given are believed to be fairly accurate in a relative sense and are supposed to represent about what would be obtained with each engine running at its most economical load with valves and pistons in good but not the best condition. In the figures given for condensing engines, the steam used by the air pump is included. To arrive at the real cost of power, the actual fuel cost and the cost of repairs, interest, depreciation, etc, should be taken into account. It can be safely assumed that with good anthracite or semi-bituminous coal a boiler will evaporate 8 pounds of water per pound of coal; hence the annual fuel cost of an engine will be:

$$\text{Annual fuel cost} = P \times \text{H.P.} \times h \times c \div (8 \times 2{,}000),$$

in which,

P = the pounds of steam used by the engine per horse power per hour.
H.P. = the average horse power developed.
h = the number of hours during the year the power is being used.
c = the cost of coal in dollars per ton of 2,000 pounds.

To the annual fuel cost thus obtained, there should be added, say 4 per cent. of the cost of the engine to cover the interest on the investment and 8 per cent. for repairs, depreciation, etc. It is assumed that when the formula (1) is used to compare condensing engines with simple engines that the boiler feed water in the case of the condensing plant is first warmed by the exhaust steam from the engine and afterward by the steam from the auxiliaries, so that there will not be enough difference in the temperature of the feed water in the two cases to warrant taking this difference into account.

No really reliable figures as to the cost of engines can be given, as this is constantly varying due to the conditions of supply and demand and the cost of materials. If an engineer is in doubt as to the type of engine needed for a special situation, bids on the types that are to be considered should be obtained, and from the prices thus obtained a decision can be made. The increased cost of the most economical engines is partly offset by the fact that not so great a capacity in boilers is required to run them, hence the cost of the boilers should usually be considered. Generally speaking, it has been found that the greater expense of economically working engines is more than offset by the gain resulting from their use. For all steam pressure over 100 pounds, with engines over 150-horse power, the compound engine in most situations, whether it is to be operated condensing or non-condensing, will save enough in fuel cost to pay for its increased first cost and cost of attendance, repairs, etc. There are situations when this statement would not be true; for instance, when the fuel cost is exceptionally low or when the demand for exhaust steam for heating or for manufacturing purposes is in excess of the steam exhausted by the engines. It would then, it is manifest, be poor policy to buy an expensive engine for the sake of getting an economical one, when the economical use of steam in the engine is no object. Again, if an engine is only to be run occasionally, as in the case of a relay engine to a water wheel, the engine should not be as costly a one as if it were to run more frequently. In the latter case, the interest on the increased cost of an economical engine over one using more fuel might be more than the difference in the fuel cost, owing to the short time that the engine is used. Generally speaking, triple expansion engines for mill or electric work with steam pressures as low as 150 pounds have not shown that the saving due to their use is sufficient to pay for their increased cost over the compound engine. Engines used in the power plants of very large buildings should, generally speaking, be of the compound type, if over 150-horse power. They are naturally run non-condensing. Another point to be considered is the increased cost of attendants of the

1. *Ante*, p. 446.

most economical engines over those with simpler parts and using more fuel.

Steam Pressure.—The steam pressure employed in simple engines may be said, generally speaking, to vary from 80 to 110 pounds above the atmosphere and in compounds from 100 to 150 pounds, although the latter are sometimes run with lower pressures than 100 pounds. The tendency is toward the higher pressures. High pressure steam, especially in compound engines, is conducive to high economy, but it should not be forgotten that high steam pressures, and by that is meant pressures of 135 pounds and over, mean increased wear on the systems, much trouble with steam piping, if unusual care is not taken in constructing it, and an increased loss from leakage and condensation; but for all these objections, the higher economy of engines with high steam pressures will more than compensate for the drawbacks if the plant is well designed and is placed in competent hands. In electric power stations and with mill and factory engines of large power, the pressure can well be from 135 to 150 pounds. In the latest large electric stations even higher steam pressures are used. High pressure steam is of special importance where compound non-condensing engines are used. For plants for very large buildings employing competent engine attendants a pressure of at least 120 pounds should be selected if this type of engine is to be used; and in large mills or large electric plants, where the steam plants will be in competent hands, the steam pressure with non condensing compound engines can well be as high as 150 pounds. Even with pressures as high as 125 pounds the steam piping should have unusual attention both in the design and erection.

Rotative Speed.—The number of revolutions an engine is to run is frequently fixed by the fact that it is to be directly connected to a dynamo which has to be run at a certain speed, or from some other cause. The rotative speed is limited by the centrifugal force developed in fly wheels when in motion, by the maximum speed at which the piston should be run and, in the case of engines with a releasing valve gear, such as the Corliss, by the tendency of the valve gear to become noisy and give trouble at too high a speed. High speed engines of 10 inch stroke with automatic cut off controlled by shaft governor, are usually run at about 325 revolutions per minute and the rotary speed is decreased to about 150 revolutions in engines of 24 inches stroke. An engine may be run at much lower rotative speeds than those mentioned, but it would then, of course, require a proportionally larger cylinder to develop the same power, other conditions being equal. With releasing gear engines with ordinary air dash-pots, the highest rotative speed that should be employed seems to be about 90 revolutions per minute. Eighty revolutions is better practice. In electric work the rotative speed is sometimes increased above 90 revolutions per minute for engines directly connected to a dynamo, but unless some special valve gear is used, permitting high speeds, the life of the engine is shortened and it is apt to be noisy and require considerable attention. The rotative speed of an engine is frequently limited by the proper speed at which the piston should be run.

Piston Speed.—Piston speed is usually defined as being the number of feet that the piston of an engine travels in a minute's time. It is obtained by multiplying the length of the stroke in feet by twice the number of revolutions per minute. Good practice with high speed engines limits the piston speed of small engines with a length of stroke of 12 inches at about 550 feet per minute, and with engines of the 2-feet stroke at about 600 feet. In larger engines 700 feet per minute is allowable, and in electric service this figure is sometimes exceeded in long stroke engines to obtain a high rotative speed. It is not well to go above 800 feet, however, for, when this piston speed is exceeded, very large ports are necessary to admit the larger amount of steam necessary with high piston speeds and these large ports increase the clearance of the engine and make it less economical in the use of steam.

Mean Effective Pressure.—When steam is admitted to a cylinder during a portion of the stroke of an engine and then further supply of it is "cut-off," the steam, after "cut off" occurs, begins to expand as the piston advances and consequently the pressure falls. The work done in the cylinder is proportional to the average effective pressure through out the stroke, hence it is necessary in proportioning cylinders to know what this average or mean effective pressure should be with different steam pressures. The mean effective pressure is one of the factors in the general equation for determining the horse power developed by an engine. Its selection is a very important matter, for on it, more, perhaps, than anything else, the economy of the engine is dependent. Theoretically the greatest amount of work is obtained from steam when it is admitted to a cylinder up to such a point in the stroke that it will afterward expand to the pressure that the engine is exhausting against. Practically, it is not well to have so complete an expansion. The more complete the expansion is (that is, the number of times the volume of steam at cut-off is expanded), the less the mean forward pressure must be, hence engines operating with high economy work, up to a certain limit, with a lower mean effective pressure than a similar engine working with a poorer economy. The lower the mean effective pressure is, however, the larger the cylinder must be to accomplish the same work, hence the expansion may be so great and the mean effective pressure so small that the saving in fuel due to this complete expansion may not pay for the increased cost of the large cylinder. This is, in brief, the commercial problem involved in the selection of cylinder sizes.

Mean Effective Pressures with Simple Engines.—In Table II. there are given about the mean effective pressures that are usually obtained with various steam pressures with Corliss and other 4-valve slow or medium speed engines, condensing and non-condensing, when the minimum amount of steam per horse power per hour is consumed. The table also shows the same data for simple single valve engines of the high speed type. The mean effective pressures are such that the engine can run at least one-third overload.

TABLE II.—*Mean Effective Pressures for Different Steam Pressures in Pounds per Square Inch, for Engines of the Simple Type.*

Steam pressure, gauge.....	80	90	100
Corliss,* condensing.....	25	30	35
Corliss,* non-condensing.....	38	42	46
Single valve, non-condensing.....	38	42	46

*These data can be applied to 4-valve, moderate or slow speed engines.

Proportioning Cylinders of Single Cylinder Corliss Engines.—The first thing to do in determining the size of cylinder for an engine to develop a given horse power is to fix the steam pressure and afterward select a mean effective pressure proper for the conditions under which the engine is to work. Having the above data, the method of determining the cylinder size will be explained, in one case where the number of revolutions is fixed and in another case where it is not. It will first be supposed that the number of revolutions have been fixed.

The general equation by which the horse power of an engine is determined is in the form:

$$\text{Horse power} = P \times l \times a \times n \div 16{,}500 \quad \ldots\ldots(2)$$

in which

P = the mean effective pressure in pounds per square inch,
l = the length of stroke in feet,
a = the mean area of the piston in square inches,
n = the number of revolutions per minute.

In equation (2) the terms H.P. (the number of horse power to be developed), P and n are assumed to be known, and transposing we have:

$$l \times a = \text{H.P.} \times 16{,}500 \div (P \times n) \quad \ldots\ldots(3)$$

Substituting the value of P, n and H.P., we can find the numerical value of l × a. Both of these quantities are to be determined. Table III. shows in columns 1 and 2 the diameter and length in inches of cylinders for Corliss engines for which practically all large engine builders carry patterns. The cylinder sizes given are taken from the catalogue of the Edward P. Allis Company. Column 3 shows the number of revolutions at which it is recommended these engines should run. Column 4 shows the product of the cylinder area in square inches by the length of stroke in feet for each cylinder, and column 5 shows the quantities given in column 4 multiplied by the number of revolutions given in column 3. Going back to the calculations, the numerical value of l × a, it will be remembered, has been found. We now look down column 4 until we find a number nearest to the numerical value of l × a. Opposite the number thus found are the dimensions of the cylinder that is seemingly required. One more operation remains. The length of stroke of this cylinder in feet should be multiplied by twice the number of revolutions that the engine is to run to obtain the piston speed; and if this exceeds good practice, as described in an earlier paragraph, a cylinder with a shorter stroke and larger diameter, but of approximately the same volume, can probably be found in the given table, which will give the power without too great a piston speed.

If the revolutions are fixed in the first place, the problem is simpler. We then can transpose equation (2) to:

$$l \times a \times n = \text{H.P.} \times 16{,}500 \div P \quad \ldots\ldots(4)$$

and after obtaining the numerical value of l × a × n, the proper diameter and stroke of cylinder and rotative speed of the engine required can be found opposite the number in column 5 of the table nearest to the numerical value of l × a × n. If there is not a close agreement between one of the

TABLE III.—*Dimensions of Cylinders and Speeds of Corliss Engines.*

Dia. Cyl. In.	Length Stroke, In.	Revs. Per Min.	Area Cyl. Sq. In. × Stroke in Ft. 1 × a.	Area Cyl. Sq. In. × Stroke, Ft. × Revs. 1 × a × n.
12	30	90	282.75	25,447
12	36	85	339.3	28,840
14	36	85	461.79	39,252
14	42	82	538.75	44,177
16	36	82	603.18	49,461
16	42	78	703.71	54,889
18	36	80	763 38	61,070
18	42	78	890.61	69,467
18	48	75	1,017 84	76,338
20	42	75	1,099.56	82,467
20	48	72	1,256.64	90,478
20	60	75	1,570.80	117,810
22	42	75	1,330.45	99,781
22	48	72	1,520.52	109,477
22	60	65	1,900.65	123,542
24	48	70	1,809.56	126,669
24	60	65	2,261.95	147,026
26	48	70	2,123.72	148,660
26	60	65	2,654.65	172,552
28	48	68	2,463.	167,484
28	60	65	3,078 75	200,118
30	48	68	2,827.44	192,265
30	60	62	3,534.3	219,126
30	72	55	4,241.16	233,263
32	48	65	3,217.	209,105
32	60	62	4,021.25	249,317
32	72	55	4,825.5	265,402
34	48	65	3,631.68	236 058
34	60	62	4,539 6	281.455
34	72	55	5,447.52	299,613
36	48	72	4,071.48	293,146
36	60	62	5,089.35	315,539
36	72	55	6,107 22	335,897
38	60	60	5,670 55	340,233
40	48	70	5,026.56	351,859
40	60	62	6,283 2	389,558
40	72	55	7,539.84	414,691
40	84	50	8,796.48	439,824
42	48	70	5,541.76	387,923
42	60	62	6 927.2	429,486
42	72	55	8 312.64	457,195
44	48	70	6,082.12	425,748
44	60	62	7,602.65	471,364
44	72	55	9,123.18	501,774
46	60	62	8 309.5	515,189
46	72	55	9.971.4	548,427
48	60	62	9,047.8	560,963
48	72	55	10,857.36	597,154

numbers in column 5 and the value of 1 × a × n, the revolutions may be increased or decreased as the former is respectively less or greater than the latter.

It was explained that Table III. gives the cylinder sizes of Corliss engines made by one company and that most builders carried patterns for these sizes. Most builders have additional patterns varying more or less in size from those given, and it may be for a particular case a builder might furnish a cylinder with slightly shorter stroke, and correspondingly greater area of piston, so that the cylinder volume would be the same. Such a cylinder would give the same power and, because of the shorter stroke, the engine would be less expensive to build, the frame, guides and all reciprocating parts being shorter. For this reason it is not well for the engineer to be too rigid in fixing the cylinder dimensions. Cylinders of different engines to do the same work should have the same volume; but the stroke should not be shortened too much.

Proportioning Cylinders for Single Cylinder High Speed Engines.—Table IV. contains the sizes of cylinders of a line of high speed automatic engines. Although no one builder carries patterns for them all, most builders have patterns for cylinders of approximately the same volume as those given in the table. The engineer can determine the size cylinder required in the manner described for Corliss engines, only using the mean effective pressure and rotative speed proper for this type of engine. A specification for this type of engine can name the length and diameter of cylinder wanted, but it should also state

TABLE IV.—*Dimensions of Cylinders and Speed for High Speed Automatic Cut-off Engines.*

Dia. Cyl, In.	Length Stroke, In.	Revs. Per Min.	Area Cyl., Sq. In. × Stroke, Ft. — 1 × a.	Area Cyl.. Sq. In. × Stroke Ft. × Revs. — 1 × a × n.
9	10	325	53	17,225
10	10	325	65	21,125
11	10	325	79	25,675
11	12	300	95	28,500
12	12	300	113	33,900
13	12	300	132	39,600
14	12	300	153	45,900
14	14	275	178	48,950
15	14	275	205	56,375
16	16	250	268	67,000
17	16	250	302	75,500
18	16	250	338	84,500
18	18	225	381	85,725
20	18	225	471	105,975
20	20	200	523	104,600

that bids upon engines of approximately the same cylinder volume will be considered. It is, of course, unfair to handicap a builder not possessing patterns of exactly the dimensions desired by demanding that he make a pattern to conform exactly to the engineer's specification.

Proportioning Cylinders for Medium Speed Engines.—It is impossible to give a table that is representative of the cylinder sizes of medium speed engines, as those four valve engines which run at higher rotative speed than Corliss engines and at lower rotative speed than the so called high speed engines are called. The reason for this is that no two builders employ the same size cylinders. It is, perhaps, just as well to select the engine size from the catalogue of one builder, using the same piston speed and mean effective pressure as for Corliss engines, and invite bids upon an engine with a cylinder or cylinders of equivalent volume. The shorter stroke should belong to the cheaper engine, other things being equal, for reasons explained above. An engine with too short a stroke in proportion to its diameter is not as economical usually, on account of greater clearances.

Determining Cylinders for Compound Engines.—The method of determining the size of cylinders of compound engines is somewhat complicated by the fact that steam has to be expanded through two cylinders. Theoretically, the size of the high pressure cylinder for a given number of expansions in the engine has absolutely nothing to do with the capacity of the engine. In fact, a simple engine with its single cylinder the same size as the low pressure cylinder of a compound engine, would theoretically, develop the same power as the compound if the cut off in the single cylinder were adjusted so as to give the same number of expansions as exist in the compound engine. In practice, however, the large number of expansions common in compound engines would not do in a simple engine, because of the excessive cylinder condensation that would occur. Dividing these expansions between two cylinders, as is done in the compound engine, reduces the condensation, and that is why compound engines are used. For the purpose of determining the cylinder sizes of a compound engine it can be assumed that all of the work is done in the low pressure cylinder and determine its size by the formulas given for the simple engines, assuming a mean effective pressure that is proper for a compound engine. After the size of the low pressure cylinder is determined, the high pressure cylinder dimensions can be found by selecting one whose volume is in the same ratio to the volume of the low pressure cylinder, as practice has found to be proper.

Mean Effective Pressures for Compound Engines.—The mean effective pressures in compound engines are different from those in simple engines for the reason that the steam pressures and ratios of expansion are higher. In Table V. there are given values that can

TABLE V.—*Mean Effective Pressures for Different Steam Pressures, in Pounds per Square Inch, for Compound Engines.*

Steam pressure, gauge	100	125	150
Corliss,* condensing	18	20	22
Corliss,* non-condensing	29	31	33
Single valve, H.-S., condensing	22	24	26
Single valve, H.-S., non-condensing	33	35	37

* These data can be applied to four-valve, moderate or slow speed engines.

be assumed for the mean effective pressures for substitution in equations (3) and (4) to find the size of the low pressure cylinder of the compound engines of various types. The mean effective pressures given

are equivalent to the mean effective pressures actually found in the low pressure cylinder added to the mean effective pressure in the high pressure cylinder multiplied by the ratio of high pressure to the low pressure cylinder area. The mean effective pressures given for compound engines are believed to be such as will ensure the lowest steam consumption per horse power. It is probable that any ordinary compound engine proportioned with these data will be able to work with one-third greater load than that assumed in determining the cylinder volumes. The maximum load possible depends on the size of the high pressure cylinder, and also on the lateness with which the cut off can occur in that cylinder.

The data given in the tables have been gathered mainly from an examination of a number of tests made by engineers known to obtain trustworthy results, where the conditions have been such as to obtain the highest efficiency. In all cases the mean effective pressure is based upon a back pressure of 16 pounds absolute in the case of non condensing engines, and a vacuum equivalent to 26 inches of mercury in the case of condensing engines. After the mean effective pressure is decided on, formula (3) should be used if the revolutions are fixed, and formula (4) if they are not determined upon, just as was done with simple engines, in calculating the area and length of stroke of the low pressure cylinder of the compound.

After the size of the low pressure cylinder is determined, the high pressure can be found by selecting one whose area is in the same ratio to the area of the low pressure cylinder, as practice has found to be proper, as has been said. There is a difference of opinion among engineers as to the proper ratio of cylinder volumes with compound engines. Some engineers proportion the cylinders so that the amount of work done in each will be the same. This results, practically with high pressures, in a considerably greater range of temperature in the high pressure than in the low pressure cylinder; and by many this is held to be bad practice, for it is well know that too great a temperature range results in excessive cylinder condensation, and it is to overcome this enemy to high economy in the steam engine that compounding is resorted to. The general practice with Corliss condensing engines, running with constant loads, has been to use a ratio of 1:3, 1:3½, and 1:4 with steam pressure of 125, 135 and 150 respectively. Recently the tendency of few engineers and builders has been toward a comparatively larger low pressure cylinder than is given. Mr. George I. Rockwood, M. Am. Soc. M.E., has persistently advocated a cylinder ratio as high as 1 to 7 for a steam pressure of 150 pounds, and the most economical compound engine ever tested, that at the Grosvenordale Mills, Grosvenordale, Conn., which gave a steam consumption under 12 pounds per horse power per hour, had a cylinder ratio of about that proportion. A number of other engines with similar cylinder ratios have shown almost as good an efficiency. With high speed automatic single valve engines the cylinder ratio varies from about 1:2½ with 100 pounds pressure to about 1:3 with a pressure of 150 pounds. An advantage in having the high pressure cylinder fairly large in comparison with the low pressure is the greater capacity for overloads that the engine will then have.

Engines with Variable Loads.—The mean effective pressures that are given for both simple and compound engines assume that the engines are to run with a steady load and that it is desirable that they should work with the highest economy. In other words, the mean effective pressures given are such as will secure the lowest steam consumption. All engines are able only to work at maximum economy at a certain load. As the load diminishes or increases, the steam consumed per horse power developed becomes greater. With a variable load an engine has to be large enough to supply the maximum power required, but when the load varies it is, generally speaking, better to proportion the engine so that it will be operating at the highest economy when working against a load that is something less than the maximum that it will be called upon to supply, for the reason that it will be working most of the time partly loaded, and it should be proportioned to meet this average load with the consumption of as little steam as possible. An engine should be of such a size that its most economical load, that is, the load under which it will operate with the least steam per horse power, is equal to the average power required, provided the maximum power that it can develop is not less than the maximum power that will be required. The mean effective pressures given in Table II. are such that the engines can easily run at one-third overload. Hence, if an engine is to furnish power where the maximum demand is 400-horse power and the average demand 300-horse power, the engine required would be one whose most economical load was 300-horse power, and 300-horse power would be the quantity substituted in the general equations (3) or (4) for determining the cylinder sizes.

Means for Diminishing Distribution Losses.

[A paper prepared by Mr. P. H. Gibbons, of Philadelphia, and read at the International Congress of Gas Engineers, Paris, France, Sept. 3, 4 and 5.]

The question of loss of gas in distribution engages the earnest thought of the gas engineer as he looks around for a suitable site upon which to erect a manufacturing station, and it remains a subject of his solicitude until the last pound of coal is carbonized, and the last foot of gas passes the consumer's meter. Fortunate is he, indeed, whose station commands the lowest point in the district to be supplied. For him the law of gravity renders valuable assistance in furnishing gas to his patrons at a minimum of pressure. Lowness of the site, however, is not the only point to be considered for the economy of distribution. It should be near the center of consumption as well, for it is a well-known fact that gas decreases in illuminating power in proportion to the length of mains through which it travels, and in proportion to the loss in illuminating power has been the percentage of loss of those gases which impart luminosity to the flame. There are ample evidences of this fact in the oily deposits found in the drips and meters and in the deposits of naphthaline crystals observed everywhere along the line of distribution. I have noticed that naphthaline is most troublesome in a coal gas works between the months of June and September, and this fact, coupled with my five years' experience with a steam jet exhauster, has led me to believe that the sudden appearance of naphthaline, so often told by engineers in their works, clogging holder inlets and outlets and mains and services, is entirely due to the fact that their condensing apparatus is not receiving proper attention. Steam is keeping too late hours with their gas, and I feel like saying to all such: Spend a portion of the time that you take to worry over the pranks of this pesky naphthaline in looking after those in charge of your condensing apparatus and I feel assured that instead of filling up your pipes and fittings, this hydrocarbon will journey on through the consumer's meter, contributing to his contentment by increasing the power of his light, to your joy by reducing the normal loss in distribution.

Gasholders as they are now built maintain constantly the maximum of pressure, and from any little chinks, cracks or crevices in the seams and around the rivet heads of their crowns and circumferences gas will escape in amazing quantities in the course of a year, for here there is no clay, no gravel, no ashes to impede its progress. Once out it is freer than the air. It is up and away beyond the reach of the olfactory organs of the gas man. Hence it is that especial care should be taken in the construction and maintenance of this portion of the distributing system. While the street main governor is not so important as it formerly was on account of the different purposes for which gas is now used demanding more pressure during more hours of the day and night, greater precautions should be taken in the laying of mains and services to counterbalance this difference. Leaks are found on street mains most frequently at the joints. A multiplicity of joints, therefore, means a multiplicity of opportunities for leakage, and I consider it sheer folly for any engineer to lay parallel mains to help supply a district when the old one becomes too small to meet the demands upon it. He simply multiplies by two, plus the extra joints where the connection is made at intersections, the opportunities for leakage. He should abandon the old main entirely and replace it by one of ample size. Leaks at the joints in gas mains are caused by contraction, unequal sagging or settling and incompetent or indifferent workmen. Leaks are caused by contraction of metal either through ignorance or carelessness of those left in charge of the operation. I have seen length after length of gas main, exposed to the rays of the hot sun for several hours, quickly lowered into the trench and as quickly yarned, cast and calked, and then left exposed to the sun's rays for several more hours before a shovelful of covering was thrown upon it. I am morally certain that when the temperature of those pipes was reduced the contraction of the metal started the lead and leaky joints followed. As soon as a pipe is laid in the trench and set to grade and direction it should have a light covering of earth thrown over a portion of its surface before the joint is cast. Sags in gas mains are usually due to improper blocking, to excavations made below its bed for sewers, water mains, conduits, etc. Leaks from this source can be greatly reduced by having a tacit understanding with the city authorities that a certain defined portion of each new street shall be reserved for gas mains and shall not be encroached upon by sewers, water mains and the various electrical conduits; and by keeping a competent inspector constantly on the ground where excavations are being made in the vicinity of gas mains, who should be provided with ample material and assistants for

shoring the pipe and recalking the joints where necessary. The fact that pipes laid in the earth are quickly hid from view, and the character of workmanship expended on the laying is so little criticised, encourages many men to seek positions as calkers and pipe layers who are totally unfit for the work. There ought to be some standard of efficiency required of every calker. For example, if a gas engineer were to say, "I will hire no man to calk a joint on the mains of my company whom I would not and could not freely trust to calk the joints of the sanitary plumbing of my own private residence. I will retain in my employ no man who is so indifferent to my interests and the interests of the company which I represent as to make frequent trips to the gin shop and the beer saloon during working hours." I believe that the engineer who would exact these two requirements of calkers could safely say that "there are no leaks at the joints on my mains due to careless or incompetent workmen." In my experience I have been able to trace much of the poor work on services and mains to overindulgence in intoxicants during working hours. Leaks in gas mains are frequently due to breaks which are caused by external pressure, by forcing fittings into holes in the main that are not sufficiently tapped out, by drilling too large holes and by uneven sagging. The first cause can be entirely avoided by laying the mains—smaller than 6-inch especially—under 3 feet of cover. The second cause is evidence of the fitter's incompetence, and the remedy suggests itself. The third cause can be entirely ob literated by placing a tee in the main where a large tap is required or by re-enforcing the main with a split-sleeve with a hole of the desired size tapped in it. The loss of gas from making taps for services, repairs and extensions, which was considerable a few years ago, can now be greatly reduced by the use of combination taps, gas cups, tallow cloth, rubber bags, plugs, soap and other devices that are familiar to modern gas men. I believe that it would be a wise precaution to place vent boxes over all mains at intervals for the future detection of leaks on all streets where traction, telegraph and telephone conduits and electric light cables make it extremely dangerous to bar the mains for leaks. The same precaution should be taken on all streets that are paved with asphalt, cement and vitrified brick that have a concrete base. These vents need not necessarily be large, and I am sure they would materially aid the gas engineer in keeping down his percentage of loss where those conditions exist.

Leaks are found more frequently on the smaller sized mains, which is entirely due to their fragility and the want of the same care taken in the laying and calking them that is bestowed on mains of greater dimensions. Cast iron mains and services under 3 inches are too small and frail for use under ground and should not be used, for they will sooner or later cause trouble and expense. A large percentage of the loss of gas in distribution occurs in the service pipes, and much of this leakage can be traced to incompetent and indifferent workmen. Here again the knowledge that bungling work can be quickly hid from the eye of competent critics induces men with little or no mechanical skill to apply for a position that they would not dare to fill if the result of their labor was to be exposed to constant view. It is an important work to lay services, and competent men should be engaged to do the work, for not only the profits of the gas company are influenced by the manner in which it is done, but precious lives are menaced as well. This latter fact has been forcibly impressed upon my mind during the past 19 months. I have had ample opportunity to note the character of the service work done in this city; I have seen thousands of service pipes uncovered for renewal. Many of them were lashed to the main with wire and twine to keep them in place, other fittings were wrapped as you would wrap a poorly fitting bung for a barrel and then pressed into the hole in the main with a smear of white lead and clay to complete the joint, and in very many cases the formality of screwing the ells, nipples and spring bends into the main was dispensed with. They were simply driven into the main with a hammer. Leaks in service pipes are found most frequently at their connection to the main at the curb cock and in the malleable fittings. Leaks at the juncture of service and main are usually due to main pipe settling, to tapping the hole too large for the fitting, and to sand holes in the malleable fittings. When a hole in the main is too large to make a safe joint it should be reamed and tapped to the next size. The danger of pulling services by sagging mains can be minimized by the use of the swing joint or service tee and ell. Too much care cannot be taken in the selection of curb cocks. They should be well made and of extra heavy material. Many engineers have abandoned their use entirely except on services of the largest size. This practice, however, can hardly be considered safe in large cities where big fires are frequent, which often spread so rapidly as to preclude the possibility of shutting the gas off from the inside of the buildings. I confidently look forward to the time when the curb cock will be substituted by one that will do the work better, that will be less liable to leak and less troublesome to get at. In this age we have automatic fire extinguishers, automatic burglar alarms, automatic gas meters, why not have automatic gas service cocks? Since a difference in its temperature of gas registered at the station meter and the same gas registeted at the consumer's meter makes a difference in the volume, care should be taken in the laying of services, the connecting of street lamps and the placing of meters to avoid changes of temperature that would adversely affect the intereats of your company.

This can, to some measure, be done by laying the services under a good depth of covering—in this latitude not less than 18 inches in the shallowest place—by the use of the anti-freezer or enlarged pipe at the bottom of the lamp post, and by impressing upon every consumer the importance of having a suitable place provided for the meter. The running of service pipes through cold vaults and area ways should be avoided as much as possible, and where it is necessary to so run them they should be protected with a covering of some kind. Instead of having a number of services and meters scattered around in odd corners and awkward places in buildings that have been enlarged or remodeled, put in one service of ample size and connect all the meters to it by means of a header. If the house risers are scattered along the front walls of the building bring them to your meters and one service; it will be more economical for you to do this. Your meters placed side by side on an even shelf look business-like and become an advertisement of your mechanical skill. In this way you lessen the opportunities for leakage by reducing the number of joints and fittings and the number of taps in your mains; you lessen the amount of condensation by decreasing the number of feet of pipe through which the gas travels before reaching the consumer's meter; you lessen the loss in distribution by the opportunity afforded to so place the meters where a difference in temperature will least adversely affect the percentage of gas accounted for; you also lessen the ability of loss of meters and gas in case of fire. The turning of one stop shuts off all the gas entering the building, and the meters being concentrated, their removal can be more quickly accomplished. Malleable iron fittings frequently contain small sand holes which, being filled with dust and grease, often escape the eye of the most careful observer. For this reason I would advocate the use of galvanized malleable fittings for service work, because in the process of galvanization these small holes are completely filled with metal.

I have noticed that the life of plain iron pipe laid in coal ashes and ground that has been filled with the ordinary refuse of a city is very limited, sometimes not extending over a period of five or six years, while galvanized water pipe laid in the same earth at the same time is still in a fair state of preservation, indicating that its life will cover a period of three or four years longer; and from these observations I am lead to believe that galvanized pipe should be used exclusively for gas service work, especially in districts where made earth of this character occurs frequently. The practice in vogue here at present is to apply several coatings of a tar preparation to the plain iron pipe, after which the service is wrapped with muslin, over which another coating of the tar preparation is spread. This process seems to be very effective. I have examined service pipes that were two years buried in coal ashes and found them in an excellent state of preservation. The cloth wrapping was nearly all rotted away, but the pipe had no sign of rust on any part of its surface. The regrettable feature of this process is that you cannot always apply the wrapping and the additional coating to the whole of the service pipe. It frequently happens that where the pipe needs protection most it gets none, a contingency that does not arise where galvanized pipe is used.

People spend considerable sums of money to have fine cement and flagstone footways laid before their residences and places of business. Once down, they are averse to having them broken or disturbed, and we are obliged to respect their wishes. In the event of either driving or boring the service pipe through the ashes, brick bats and broken stone which usually form a base for these footways, the first coating of the tar preparation is worn off. The result is that one-half of the service may remain for 20 or even 30 years in an excellent state of preservation, while the life of that portion which has been imbedded in the ashes without protection will not extend beyond 5 or 6 years.

I have frequently observed that service pipes rust out and leak just inside the cellar wall, while the rest of the pipe is in good condition. Leaks at this point, which are quite frequent, could be greatly reduced by applying a coat of paint to the service from time to time.

Gas meters, like clocks, watches and other mechanical contrivances, are apt to run slow oftener than they do fast when their mechanism becomes worn and old, and sometimes a very considerable portion of

the loss in distribution can be traced to this source, which can be minimized by systematically overhauling all meters that are in use at least once in every four years.

I believe much good can be accomplished by noting on the record of each service the kind of earth in which it is imbedded. If this were done you would, in a few years, by careful observation be enabled to determine with some degree of exactness the life of your services along the line of distribution. I have uncovered service pipes that were said to be down for 40 years and found them in a fair state of preservation; others again that were only down 10 years and had not a sound spot in them. Hence the importance of knowing what part the soil in the different sections of the district is playing in the ruin of your distributing system.

Much good can be accomplished by encouraging people to promptly enter complaint at the gas office as soon as they detect the odor of escaping gas on their premises or in the street, and by systematic examinations of all joints, pipes and fittings exposed by the gas company's employees at all times.

Before closing I feel that I ought to say that I am not insensible to the fact that some writers attribute much of the leakage in the joints of gas mains to expansion and contraction due to the difference in the temperature of the earth in summer and winter seasons. In proof of this theory they call attention to the fact that small leaks are more frequent in gas mains than they are in water mains, which is due, so they contend, to the difference of temperature being greater in the gas mains than in the water mains. I have always questioned their proof and, therefore, have not taken kindly to their theory.

He is a very dull plumber or water department employee who has not discovered that a small quantity of common salt applied to a weeping joint at the bell or ferrule of a water main will stop the weeping long before its presence can be detected from the surface. This fact is frequently made use of by plumbers and water departments; and even if small leaks of this character escape their observation, the earth surrounding the leaky joint furnishes sufficient corrosive substances to stop small leaks in water mains. These, in my judgment, are the best reasons why small leaks are less frequent in water than in gas mains. Gas is a more subtle prisoner than water. It spreads an oily film that defies corrosion over the small aperture through which it escapes into the earth.

In concluding let me express the hope that I have expressed some thought or made some suggestion that will aid the gas man in reducing the normal loss of gas in distribution. This much accomplished, I shall feel amply repaid for the time spent in preparing this paper for the International Congress of the Gas Industry.

New Experiments on the Diesel Oil Engine.

Engineering reports that at the *Congrés de Mechanique* at Paris, in July last, an interesting paper on recent tests of the oil engine bearing his name was read by Mr. Diesel. A short summary of these tests will be important as the results are very economical. It is a single cylinder, single acting, vertical engine, and without tube or electrical ignition, the required temperature for ignition of the charge of oil and air being obtained by the previous compression of the air up to about 57 atmospheres, equal to 800 pounds per square inch. There are two of these engines running regularly at the Vincennes Exhibition, near Paris. Many members of congress visited them, and indicator diagrams were taken in their presence. These motors work well, and with but little noise, and the exhaust gases are quite invisible. The little white smoke usual with most oil engines does not exist, and its absence showed very good combustion.

We now add a summary of the Diesel tests at Augsburg in December, 1899: The engine was of 30-horse power nominal; diameter of cylinder, 30 centimeters (11.8 in.); stroke, 46 centimetres (18 in.). Twelve separate tests were made, and all with the same raw naphtha from Russia, also 12 others with petrole from Roumania. Both these oils had the same heating value, viz., 18,000 thermal units per pound by calorimeter (lower heating value). In the first 12 tests, for which we now give some figures, the brake-horse power was varied from 40 as a maximum to 7 as a minimum. The second set of tests were so similar in their results, that we do not propose to give them. The number of revolutions per minute did not vary much—about 176 with high loads to 183 at light loads; indicated horse power from 57 maximum to 17 when running without load. The most economical load was found to be 33 brake horse power and 47 indicated horse power; weight of oil used per brake horse power per hour was 208 grammes, equal to 0.46 pound. Several experiments gave 213 and 218 grammes. With 10 brake horse power it was 320 grammes, a decreasing load giving an increasing consumption of oil, as usual. The results are all piloted on curves, and agree very well. The most interesting figure of merit for comparing the different experiments is the thermal efficiency per brake horse power per hour, which for 33 brake horse power was 30.7 per cent. In other words, about 31 per cent. of all heat given to this oil engine was converted into work on the brake; for 10 brake horse power it was 20 per cent. When we remember that the most economical steam engines by the best makers, using high pressure steam and well jacketed, of about 1,000-horse power only convert about 15 to 16 per cent. of heat received into brake horse power, the above is an excellent figure, and about double that of such a steam engine of large power. The mechanical efficiency is, however, low—about 70 per cent. In other words, the oil engine and special air pump require 30 per cent. for a load of 33 brake horse power. The air pressure is about 800 pounds per square inch, and the maximum initial pressure in the motor cylinder from the indicator diagram was 450 pounds to 500 pounds per square inch. Such high pressures require great care in workmanship, and all joints, valves, and piston rings must be tight. These and other tests prove that the best thermal efficiency of this oil engine is obtained when the actual combustion or indicator curve approaches the isothermal. They also show the great importance of perfect combustion, and that the mixture of very hot air and oil gas should be, and is, very complete. A bad admixture of air and gas of too low a temperature results in a smoky exhaust and bad combustion. The exhaust gases in all oil engines should be invisible as in this engine.

Lighting Gas.—Some experiments were also made on the same engine with town gas. The air was compressed for ignition to about 560 pounds per square inch. The thermal efficiency per brake horse power was 26½ per cent. Mechanical efficiency 75 per cent. Gas consumed, 16.6 cubic feet per brake horse power per hour. These results are a little better than those of the best English gas engines of about the same power.

Solid Fuel.—Some tests were made on the same engine with finely pulverized coal injected into the motor cylinder, and mixed with the very hot and highly compressed air. The oil engine used did not, however, prove suitable for solid fuels. Great difficulty was experienced at first, but it was overcome by the following method: The powdered coal was well mixed with the air during the suction stroke of the air pump, and the mixture of coal and air afterwards compressed. To facilitate the ignition of the charge a very small quantity of ordinary liquid oil was injected into the highly compressed mixture of coal and hot air. The internal oiled surfaces of the cylinder were, however, found to be covered rapidly with the powdered coal. The result of these experiments led to the conclusion, that a special motor should be made for powdered coal provided with a special combustion chamber, and separate from the motor cylinder. Such, in short, were the difficulties met with, that we are of opinion that having such an excellent pure combustible of high heating value like oil, it does not seem advisable to make complicated arrangements to burn properly the solid small particles of powdered coal.

The cost of drying, grinding and sieving good coal will probably increase the cost to nearly that of oil, particularly if the heating value is considered. Oil requires no such treatment, and is ready for use.

Some additional tests were also made with this engine with generator or poor gas. The results were about the same for heat efficiency as with town gas.

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

Mr. Frank E. Chandler has been re elected President and General Manager of the Malden and Melrose (Mass.) Gas Light Company.

The manufacturing plant of the Woodstock (Vt) Gas Light Company was shut down on the 16th inst.

At the annual meeting of the Seattle (Wash.) Gas and Electric Company the retiring Board of Trustees was re elected. The Board subsequently perfected the following organization: President, H. C. Henry; Vice-President, M. H. Young; Secretary and General Manager, C. R. Collins.

Next Wednesday Mr. Edward Moir, temporary receiver for the Clyde (N. Y.) Gas and Electric Company, will offer all the privileges

and properties of that corporation for sale at public auction. The sale is subject to a $25,000 mortgage held by the Trust and Deposit Company of Onondaga.

"S. R. B." is informed that the annual meeting of the company concerned in his inquiry will be held October 10th.

THE Massachusetts Board of Gas and Electric Light Commissioners has authorized the Taunton Gas Light Company to issue $80,000 of new stock and $90,000 of bonds, the proceeds of the issue to pay for the construction of a new works at Wier Village.

MR. FRANK D. MOSES, Chief Engineer of the Trenton (N. J.) Gas and Electric Company, writing from Trenton under date of the 17th, says:

To the Editors AMERICAN GAS LIGHT JOURNAL: We note that in your issue for September 10th you published an item stating in substance that we are doing extensive advertising and that we have 1,600 gas stoves connected up in Trenton. Your informant must have had his figures mixed. We have set over 3,600 stoves in this city during the past two years, 1,884 of which were set since the 14th May, 1900, and we are still selling them, having taken orders for 121 during the past week, 31 of the latter being booked on Saturday. You will find enclosed a sample of our advertising style, and you can draw your own conclusions whether or not it pays to advertise."

MR. J. S. PERKINS has been appointed to a prominent position in the management of the Lakeville (Conn.) Gas Company.

THE properties of the Tonawanda (N. Y.) Gas Light Company, the Standard Gas Company of North Tonawanda, and the Tonawanda Lighting Company have consolidated under the title of the Tonawanda Lighting Company. The capital stock of the concern has been fixed at $200,000. It is understood that important plant betterments are to be made.

AT the annual meeting of the Worcester (Mass.) Gas Light Company the officers chosen were: Directors, Chas. D. Lamson, A George Bullock, Joseph H. Clarke, Francis H. Dewey, Albert Wood and Samuel B. Woodward. President, Charles D. Lamson; Treasurer and Clerk, James P. Hamilton. It was also voted to increase the capital stock from $500,000 to $700,000, and the Directors were instructed to appear before the State Board of Gas and Electric Light Commissioners for permission to make the increase. The plan is to take up $100,000 in bonds now due and to expend the balance of the proceeds received from the sale of the new stock in extending the mains of the Company and enlarging the manufacturing plant. Stockholders of record will be given the first privilege of taking the new stock at the price fixed by the State Commissioners. Each block of five shares of the old stock will be entitled to two shares of the new stock.

THE Essex and Hudson Gas Company, of Newark, N. J., is adding largely to its office capacity at Broad street and Central avenue. The main portion of the additions will be devoted to show rooms for gas cooking and heating appliances, improved burners, etc.

THE new issue of stock in the New Haven (Conn.) Gas Light Company (10,000 shares of the par value of $25 each) has been made.

THE Council of Steelton, Pa., is still haggling over the terms of the ordinance under which it is proposed to permit the operation there of a gas works.

THE Codorus Gas Company, of Jefferson, Pa., has been incorporated by Messrs. C. R. Fritcher, E. H. Wert, H. B. Garman, George W. Wambaugh and E. J. Stackpole, with a capital of $10,000. The avowed object of the concern is to supply gas "for lighting purposes only" to the citizens of York, Pa., and the adjoining townships and boroughs.

THE proprietors of the Clinton (Ia.) Gas Company have determined to make important plant betterments, the estimated cost of which is $100,000. The scheme includes a new retort house, new purifiers and a storage holder of a capacity of 200,000 cubic feet. Several miles of distributing mains will also be placed.

THE reconstruction of the Florence Gas Light and Power Company, of Florence, Ala., is well underway.

MR. CHARLES WATSON, formerly Secretary and Treasurer of the Camden (N. J.) Gas Light Company, has been elected General Manager of the South Jersey Gas, Electric and Traction Company, which concern succeeded to the properties and rights of the Camden Company.

THE Westmoreland Light, Heat and Power Company, of Greenburg, Pa., "to produce electricity, steam and gas for lighting, heating and power purposes," has been incorporated by Messrs. Edward E. Robbins, Morris L. Painter, Winfield S. Lane, Edward H. Blair and Gardner W. Kimball. It is capitalized in $500,000.

THERE are 400 lamps of the improved Welsbach street lighting type in use on the streets of Dayton, O.; and they are giving unqualified satisfaction.

THE offices and showrooms of the Woonsocket (R. I.) Gas Company have been removed to the Unity building.

THE proprietors of the Northampton Gas Company have applied to the Massachusetts State Board of Gas and Electric Light Commissioners for the right to increase their capital stock in the sum of $25,000.

MR. MCCUEN, Superintendent of Lamps and Lighting, for Baltimore, Md., insists that the rate charged for gas for public lamps shall be lower than that charged to ordinary consumers, which rate is $1.10 per 1,000 cubic feet.

THE St. Louis (Mo.) *Republic* says that 3,359 lamps of the Welsbach type are now in use for the public lighting of the city, and asserts that 3,00 more will be ready for use there before October 1st.

THE inclined retorts in the new generating house of the Louisville Gas Company are yielding results considerably beyond the expectations and hopes of Chief Engineer Barret.

A CORRESPONDENT in Chester, Pa., writing under date of the 14th inst., forwards the following: "Chester is to have dollar gas for all purposes after January 1st, next. This, as the local papers say, is very satisfactory news to the residents, and official action thereon was taken by the Directors of the Delaware County Gas Company at a meeting held last evening. The Board decided with unanimity to reduce the price of illuminating gas to an even dollar per 1,000 cubic feet, a step which is destined to make the use of gas as an illuminant much more general in this city. This means a reduction of 50 cents per 1,000 in the price of gas for illuminating purposes, and places Chester in the van for cities of this class in the matter of cheap light. The present rate is $1.60 per 1,000 for illuminating purposes, with a discount of 10 cents for payment of bills within 10 days of presentation, making the net rate now $1.50. After the first of the new year the rate will be $1.10 for gas for all purposes, illuminating and fuel, with a reduction of 10 cents for prompt payment of bills, making the net rate to consumers $1. With a population of 35,000 in round numbers, Chester will hereafter have the benefit of as low a gas rate as is enjoyed by the great cities, where the per capita consumption is much greater, and the cost of manufacture is considerably less than it is here. The instances where cities of this size have dollar gas are very few indeed, and Chester's desirability as a place of residence is enhanced by the advantage of cheap gas service. The action of the Gas Company was taken with the idea that the increased consumption of gas, due to the fact that it can now be burned as cheaply as coal oil and without the dangers of that form of illumination, would induce a great many householders to have their homes piped and gas run in, thus increasing the consumption and enabling the Company to make a large quantity of gas at a less cost than at present. Chester has never been considered a good gas town, as the number of houses here in which coal oil lamps and other old fashioned methods of lighting are still used is very large. The proportionate gas consumption in Chester is decidedly low, being far below the 1,000 cubic feet per capita which is considered a fair average in a city of this size. But the officers of the Gas Company believe that with the inducement of the low prices now offered, and the great convenience of gas as an illuminant, the pro rata consumption here will be largely increased and the Company will, in the end, benefit by the reduction in the cost to its patrons. With illuminating gas at $1 the use of this method of lighting will be as economical as oil, it is said, without the attendant trouble and danger. As an official of the Company said last evening, this step has not been taken in opposition to the electric light company or with a desire to provoke rivalry in that direction, but with the idea of extending the

(*Concluded on page 494.*)

THE AMERICAN GAS LIGHT JOURNAL

A. M. CALLENDER & CO.,
PROPRIETORS.

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ELBERT P. CALLENDER,
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CHAS. E. SANDERSON,
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AGENTS:
New York—American News Co. 39 and 41 Chambers St.
Germany—Lemcke & Buechner, of New York.
England—Aug. Siegle, 30 Lime Street, London.

MONDAY, SEPTEMBER 24, 1900.

(*Continued from page 493.*)

use of gas throughout the city and inducing the people to give up their lamps and have the more convenient illuminant instead. It is a bold and progressive move on the part of the Gas Company, but one which will likely result in ultimate benefit to the shareholders and enable the corporation to pay the long-deferred dividend on its stock. At any rate it is a move which will commend itself to householders and business men, and undoubtedly will be met, as it should be, by the evidences of popular appreciation in the direction of a largely increased consumption of the Company's product."

THE output of the Tokio (Japan) Gas Company for last year was 145,088,100 cubic feet, all made from coal, chiefly obtained from British Columbia. The yield to the gross ton was 10,029 cubic feet, and the coal carbonized amounted to 14,467 tons. The unaccounted-for gas is reported at 12½ per cent. of the make. The Company has 10,553 consumers, supplies gas to 1,130 street lamps, and has 242 gas engines on its mains, the total horse power of the engines being 1,234. The main system is returned at 177 miles. The coke produced was 9,609 tons, and the tar made amounted to 135,044 gallons. The Company's engineer is Mr. S. Hiramatsu, who kindly gave us the above statement while stopping in New York awaiting the sailing of his steamer for England, where he expects to remain until next spring. Mr. Hiramatsu says that the Company will completely rebuild its works next year.

THERE is a probability that the projected works for DeKalb, Ills., will be constructed this fall.

THE American Bridge Company informs us that Mr. August Ziesing has been appointed its general Western representative, with headquarters in Chicago.

THE authorities of Redlands, Cal., have passed an ordinance permitting the projectors of the Redlands Gas Company to maintain and operate a gas plant in that city.

MRS. LAURA B. CLEMENTS, of Colusa, Cal., recently sued the Colusa Gas Company for damages sustained by the pollution of a well, the water from which was used in her household for drinking purposes, caused by imperfect drains from the gas works. The case was tried before a jury, who awarded her the sum of $191.

THE estimated cost of public lighting in Washington, D. C., for the year 1901, is returned at $260,000. This sum merely covers the actual cost of the gas, electric and naphtha lamps to be employed, and so makes no account of the sum necessary to keep the lighting department going.

THE holder for the new plant of the American Gas Company's property at Rockford, Ill., is virtually ready to be put in commission.

LARGE additions to the main system of the New Haven (Conn.) Gas Light Company are being arranged for.

MR. S. E. GILLETTE has been appointed Engineer to the Danvers (Mass.) Gas Light Company.

THE Peoria (Ill.) Gas Companies have determined to test the validity of the recently adopted ordinance directing them to fix their maximum selling rate at 75 cents per 1,000 cubic feet.

The Market for Gas Securities.

Animation and weakness were the characteristics of the city gas share market since last Friday. To-day (the 21st) the lowest point reached in Consolidated for a long time was recorded. An odd lot sold at a trifle under 164, but towards the close a sharp recovery was made, with the ending rate at 166 to 167. It is queer that weakness should mark the value of Consolidated at a time when every actual feature in connection with it looks for strength. However, it is fair to presume that the anthracite mining troubles, together with the political agitation, are largely responsible for the senseless decline in Consolidated. We have no doubt whatever that before next Christmas even the Company's new total capitalization will be selling over 200.

Brooklyn Union, without an actual sale today (Friday), is reported as offered at 170. It is quite safe to assert that a bona fide 500-share purchasing order would send it to 190. Peoples of Chicago, is selling at the absurdly low figure of 88¾. Baltimore consolidated is nominally a trifle weaker, with 55 bid for it. There is but little doubt that Mr. C. H. Dickey, of Baltimore, will soon be actively identified with the Company, which will be to its advantage. All gas bonds hold their own fairly well.

Gas Stocks.

Quotations by George W. Close, Broker and Dealer in Gas Stocks.

16 WALL STREET, NEW YORK CITY.

SEPT. 24.

☞ All communications will receive particular attention. ☜ The following quotations are based on the par value of $100 per share.

N. Y. City Companies.	*Capital.*	*Par.*	*Bid.*	*Asked.*
Consolidated—Ex rights....	$4,595,300	100	166	167
Central Union, Bonds, 5's.	3,000,000	1,000	106	107½
Equitable Bonds, 6's.....	1,000,000	1,000	105	..
" 1st Con. 5's.....	2,300,000	1,000	120	..
Metropolitan Bonds	638,000	..	108	112
Mutual.....	3,500,000	100	297	305
" Bonds.....	1,500,000	1,000	100	102
Municipal Bonds.....	750,000	..	..	..
New Amsterdam Gas Co...				
Bonds, 5's	11,000,000	1,000	106	106½
Northern Union, Bonds, 5's.	1,250,000	1,000	102	103
New York and East River .				
Bonds 1st 5's.....	3,500,000	1,000	105	106⅜
" 1st Con. 5's.....	1,500,000	..	115	..
Richmond Co., S. I.....	348,650	50	70	..
" Bonds.....	100,000	1,000	..	..
Standard.....	5,000,000	100	121	125
Preferred.....	5,000,000	100	141	145
Bonds, 1st Mortgage, 5's	1,500,000	1,000	116	114
Yonkers	299,810	500	130	.
Out-of-Town Companies.				
Brooklyn Union	15,000,000	100	160	170
" " Bonds (5's)	15 000,000	1,000	118	119
Bay State.....	50,000,000	50	1	1¼
" Income Bonds.....	2,000,000	1,000		75
Binghamton Gas Works.. .	450,000	100	33½	30
" 1st Mtg. 5's.....	475,000	1,000	96½	99½
Boston United Gas Co.—				
1st Series S. F. Trust....	7,000,000	1,000	82	85
2d " " "	3,000,000	1,000	47½	50
Buffalo City Gas Co.	5,500,000	100	4	4¼
" " Bonds, 5's	5,250,000	1,000	64	67
Capital, Sacramento	500,000	50	..	35
Bonds (6's)..	150,000	1,000	..	..
Central San Francisco.....	2,000,000	..	106	108
Chicago Gas Co. Guaranteed Gold Bonds.....	7,650,000	1,000	104	104¼
Cincinnati G. & C. Co.....	8,500,000	100	199½	201
Columbus (O.) Gas Co., 1st Mortgage Bonds.....	1,207,000	1,000	106	107
Columbus (O.) Gas Lt. & Heating Co	1,692,780	100	60	65
Preferred.....	3,086,500	100	84	86
Consumers, Jersey City Bonds	800,000	1,000	102	105
Consumers, Toronto.....	1,700,000	50	230	235
Consolidated, Baltimore...	11,000,000	100	54¾	55¼
Mortgage, 6's.....	3,600,000	..	..	118
Chesapeake, 1st 6's.	1,000,000	..	..	..
Equitable, 1st 6's.	910,000	..	..	..
Consolidated, 1st 5's....	1,490 000	..	..	112
Consolidated Gas Co. of N.J.	1,000,000	100	12½	15
" Con. Mtg. 5's.....	380,000	1,000	82	86
Consolidated G. & E. Co.'s., Little Falls, N.Y.....	90,000	100	..	100
Bonds.....	75,000	..	..	100
Detroit City Gas Co.....	4,560,000	50	95	97
" Prior Lien 5's.....	4,598,000	1,000	99½	100
Detroit Gas Co., 5's....	386,000	1,000	100	101
" Inc. 5's.....	16,000	100	94	94½
Equitable Gas & Fuel Co., Chicago, Bonds.....	2,000,000	1,000	..	101
Essex and Hudson Gas Co.	6,500,000	..	35	40
Fort Wayne	2,000,000	..	35	41
" Bonds.....	2,000,000	..	60	64
Grand Rapids Gas Lt. Co..	1,000,000	50	105	107
" 1st Mtg. 5's.....	1,125,000	1,000	..	.
Hartford.....	750,000	25	..	230
Hudson County Gas Co., of New Jersey.....	10,500,000	..	25	..
" Bonds, 5's.....	10,500,000	..	101	103
Indianapolis.....	2,000,000	..	70	80
" Bonds, 6's.....	2 650,000	..	98	100
Jackson Gas Co.....	250,000	50	70	75
" 1st Mtg. 5's.....	250,000	1,000	101	102½
Kansas City Gas Light Co., of Missouri	5,000,000	100	..	36
Bonds, 1st 5's.....	3,822,000	1,000	101½	103
Laclede, St. Louis	7,500,000	100	70	72
Preferred.....	2,500,000	100	99	100
Bonds	10,000,000	1,000	110	110¼
Lafayette Gas Co., Ind....	1,000,000	100	35	40
Bonds	1,000,000	1,000	60	65
Louisville.....	2,570,000	50	110	120
Madison Gas & Elec. Co....	400,000	100	70	75
" 1st Mtg. 6's.....	350,000	1,000	102½	108
Montreal, Canada	2,000,000	100	182	184½
Newark, N. J., Con. Gas Co	6,000,000	..	..	55
Bonds, 6's.....	4,600,000	..	..	103
New Haven.....	1,000,000	25	280	300
Nashville Gas Lt. Co.....	1,000,000	50	110	..
Oakland, Cal.....	2,000,000	..	46	47
" Bonds.....	750,000	..	..	..
Peoples G. L. & Coke Co., of Chicago.....	25,000,000	100	88½	88¾
Peoples Gas Lt. & Coke Co., Chicago, 1st Mortgage....	20,100,000	1,000	90¾	91
2d "	2,500,000	1,000	104	105
Rochester Gas & Elec. Co..	2,150,000	50	88	..
Preferred.....	2,150,000	50	118	..
Consolidated 5's	2,000,000	..	87¾	90
San Francisco, Cal.	10,000,000	100	47¼	47¾
St. Paul Gas Light Co.....	1,500,000	100	48	52
1st Mortgage 6's.....	650,000	1,000	82	85
Extension, 6's.....	600,000	1,000	..	..
General Mortgage, 5's..	2,493,000	1,000	88	90¼
St. Joseph Gas Co.....	1,000,000	100	95	95
" 1st Mtg. 5's.....	750,000	1,000	96½	98
Syracuse, N. Y.	1,750,000	100	..	13
Bonds.....	1,612 000	1,000	88½	93
Washington, D. C	2,600,000	20	266	267
First mortgage 6's.....	600,000	..	.	..
Western, Milwaukee	4,000,000	100	90	91
Bonds, 5's.....	3,830,500	.	107	107½
Wilmington, Del.....	600,000	50	200	210

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DIVIDEND NOTICE.

OFFICE OF THE UNITED GAS IMPROVEMENT CO., N. W. CORNER BROAD AND ARCH STS., PHILA., PA., Sept. 12, 1900.

The Directors have this day declared a quarterly dividend of 2 per cent. (one dollar per share), payable October 13, 1900, to stockholders of record at the close of business, Sept. 29. Checks will be mailed.

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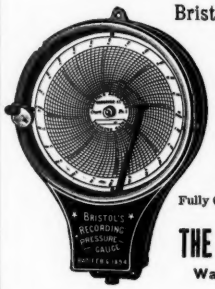

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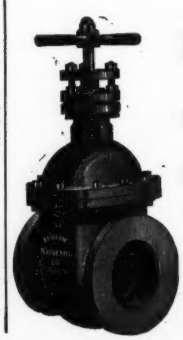

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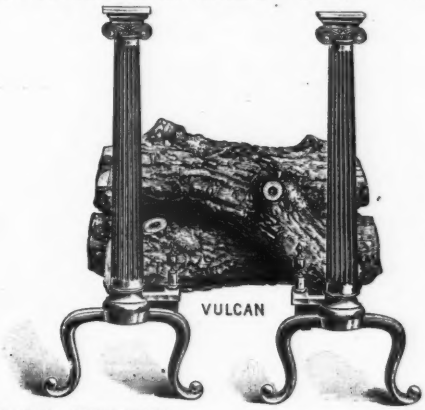

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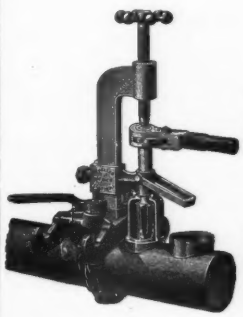

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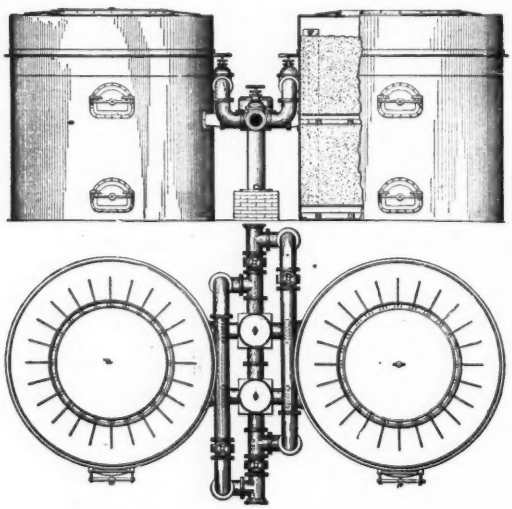

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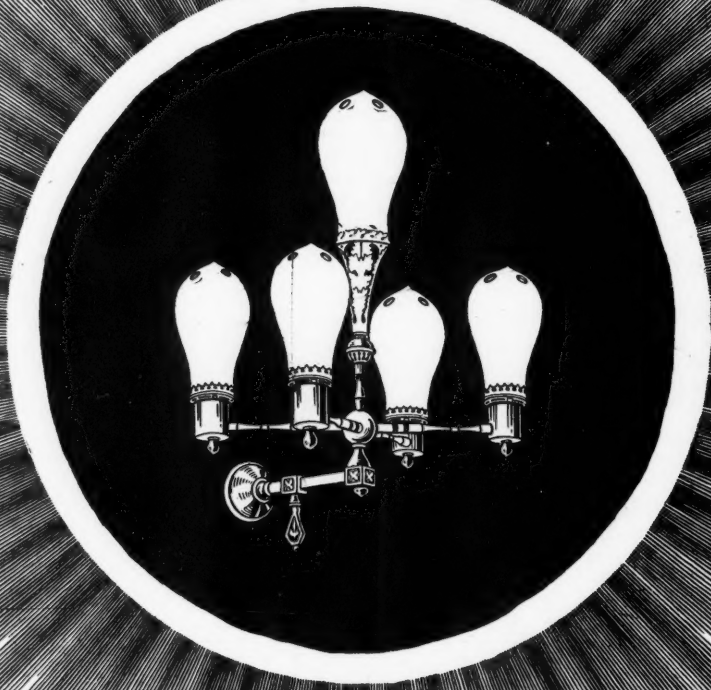

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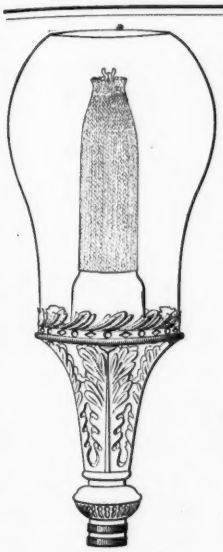

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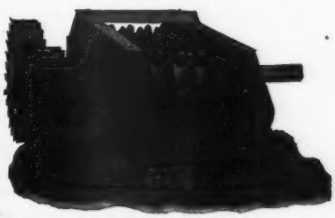

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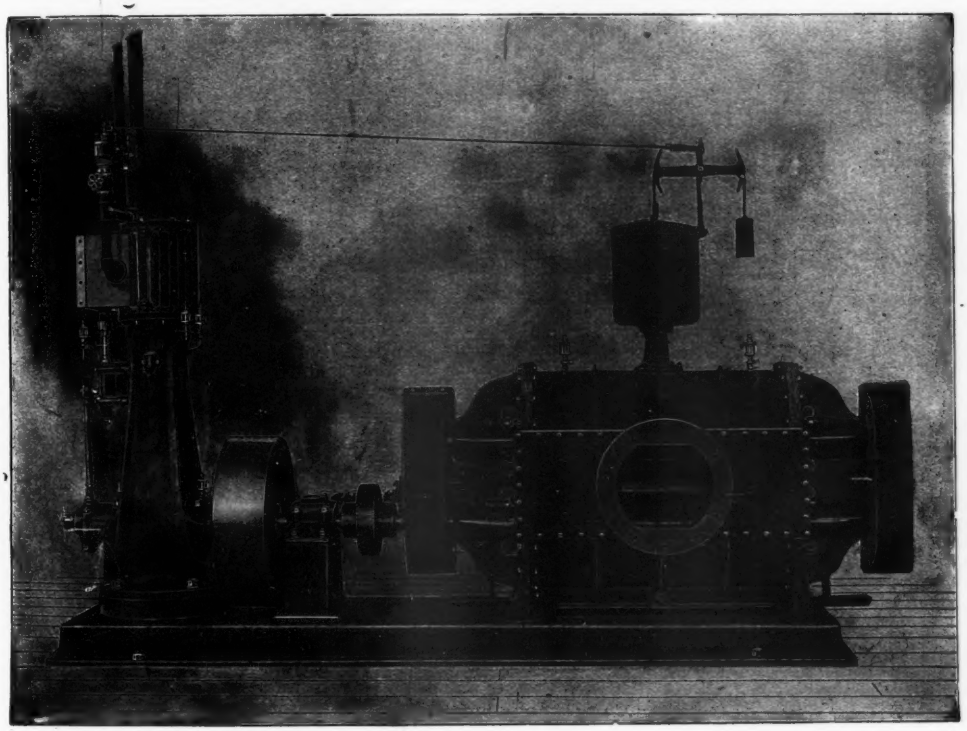
EASIER TO ADJUST THAN ANY OTHER GOVERNOR.



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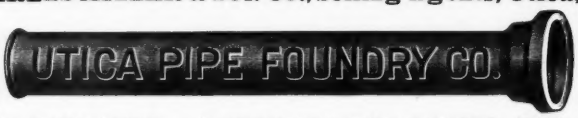

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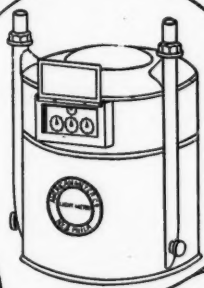
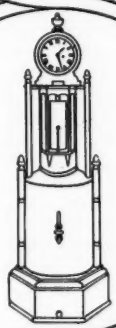
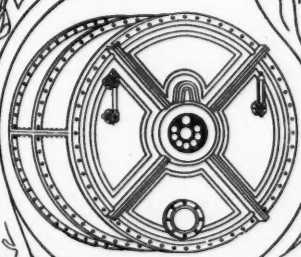






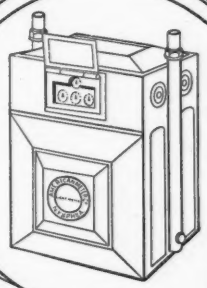
PUBLIC LIGHTING TABLE.

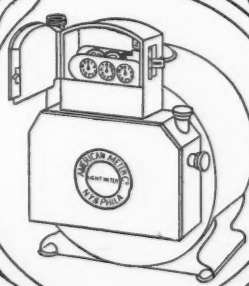
OCTOBER, 1900.

Day of Week.	Table No. 1. Following the Moon. Date.	Light.	Extinguish.	Table No. 2. New York City. All Night Lighting. Light.	Extinguish.
				P.M.	A.M.
Mon.	1	10.00 FM FQ	5.00 AM	5.30	5.00
Tue.	2	11.00	5.00	5.30	5.00
Wed.	3	12.10 AM	5.00	5.30	5.00
Thu.	4	1.20	5.00	5.30	5.00
Fri.	5	2.40	5.00	5.30	5.00
Sat.	6	3.50	5.00	5.30	5.00
Sun.	7	No L.	No L.	5.30	5.00
Mon.	8	No L. FM	No L.	5.20	5.10
Tue.	9	No L.	No L.	5.20	5.10
Wed.	10	6.00 PM	7.50 PM	5.20	5.10
Thu.	11	6.00	8.40	5.20	5.10
Fri.	12	6.00	9.40	5.20	5.10
Sat.	13	6.00	10.40	5.20	5.10
Sun.	14	5.50 LQ	11.40	5.20	5.10
Mon.	15	5.50	12.40 AM	5.10	5.20
Tue.	16	5.50	1.40	5.10	5.20
Wed.	17	5.50	2.40	5.10	5.20
Thu.	18	5.50	3.40	5.10	5.20
Fri.	19	5.50	4.30	5.10	5.20
Sat.	20	5.50	5.20	5.10	5.20
Sun.	21	5.40	5.20	5.10	5.20
Mon.	22	5.40	5.20	5.00	5.30
Tue.	23	5.40 NM	5.20	5.00	5.30
Wed.	24	5.40	5.20	5.00	5.30
Thu.	25	5.40	5.20	5.00	5.30
Fri.	26	5.40	5.20	5.00	5.30
Sat.	27	5.40	5.20	5.00	5.30
Sun.	28	7.50	5.30	5.00	5.30
Mon.	29	8.50	5.30	4.45	5.35
Tue.	30	10.00 FQ	5.30	4.45	5.35
Wed.	31	11.00	5.30	4.45	5.35

TOTAL HOURS LIGHTING DURING 1900.

By Table No. 1.	Hrs.Min.	By Table No. 2.	Hrs.Min.
January	230.50	January	423.20
February	175.40	February	355.25
March	189.00	March	355.35
April	160.30	April	298.50
May	150.40	May	264.50
June	137.00	June	234.25
July	152.00	July	243.45
August	171.50	August	280.25
September	187.20	September	321.15
October	213.10	October	374.30
November	221.50	November	401.40
December	231.50	December	433.45
Total, yr.	2221.40	Total, yr.	3987.45

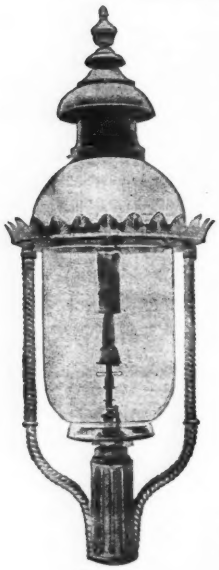




NEW YORK, 33 Nassau St. PHILADELPHIA, Broad and Arch Sts. CHICAGO, 54 Lake St.

Welsbach Street Lighting Company

.... OF AMERICA ....



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Which includes its specially DESIGNED AND PATENTED BURNER for STREET and PARK LIGHTING exclusively.

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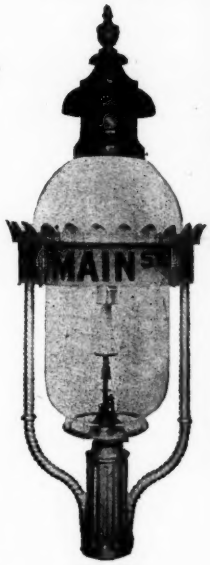
By means of the Welsbach System of street lighting the superiority of GAS over electricity for street lighting has been fully demonstrated.

POINTS OF MERIT:

It is { Economical, Attractive, Successful, Up-to-date.

IT LIGHTS THE STREET.

Where there are no gas mains we can furnish an equally good light by our SELF-GENERATING NAPHTHA WELSBACH BURNER, and thereby supply a uniform light in all localities.



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FINEST EXAMPLE

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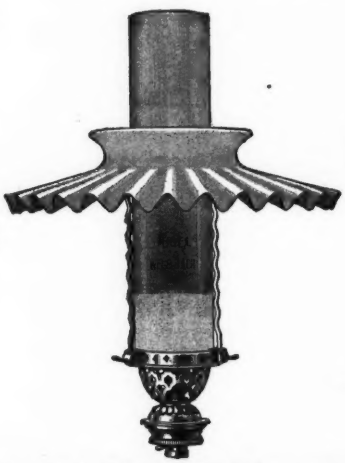
GAS LIGHT

EVER EXHIBITED.



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THE STANDARD DOUBLE SUPERHEATER LOWE WATER GAS APPARATUS.

CONTRACTS RECEIVED SINCE JANUARY 1, 1900.

	SETS.		SETS.
DANSVILLE, N. Y.	1	CARBONDALE, PA.	1
WEST CHESTER, PA.	1	HACKENSACK, N. J.	1
COHOES, N. Y.	2	TIFFIN, O.	1
OGDEN GAS CO., CHICAGO	1	MOUNT HOLLY, N. J.	1
CENTRAL UNION GAS CO., NEW YORK	1	SEATTLE, WASH.	1
SPENCER, MASS.	1	TARRYTOWN, N. Y.	1
SAN FRANCISCO	1	HOBOKEN, N. J.	2
BROOKLYN UNION GAS CO., BROOKLYN	1	PATERSON, N. J.	2
RICHMOND, VA.	2	NEWARK, N. J.	2
CAMBRIDGE, MASS.	2	JERSEY CITY, N. J.	1

NUMBER OF SETS	26
TOTAL SETS INSTALLED TO JANUARY 1, 1900	327
TOTAL SETS INSTALLED TO DATE	353
TOTAL DAILY CAPACITY	226,600,000 Cubic Feet.

The United Gas Improvement Company,

Broad and Arch Streets, Philadelphia.

Established 1858. Incorporated 1890.
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Estimates Furnished on Application for Most Successful Style of Construction.

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RETORT WORKS

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BENCH SETTINGS,

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In Kegs, 100 to 200 " " 6 " "
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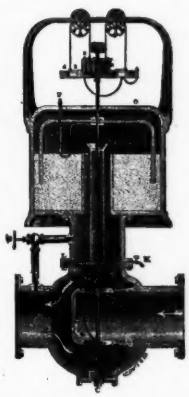

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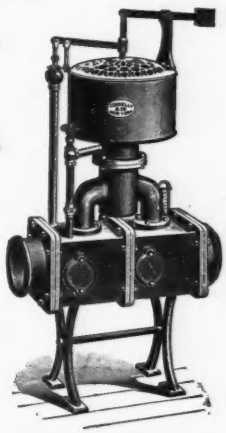
"Iron Sponge" and Natural Oxide
FOR GAS PURIFICATION.
EXHAUSTERS, ETC.



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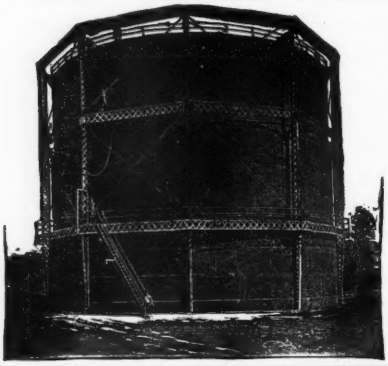

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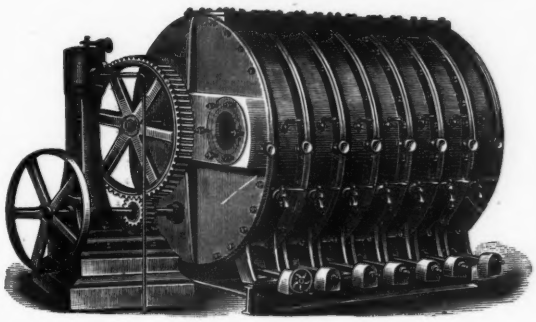

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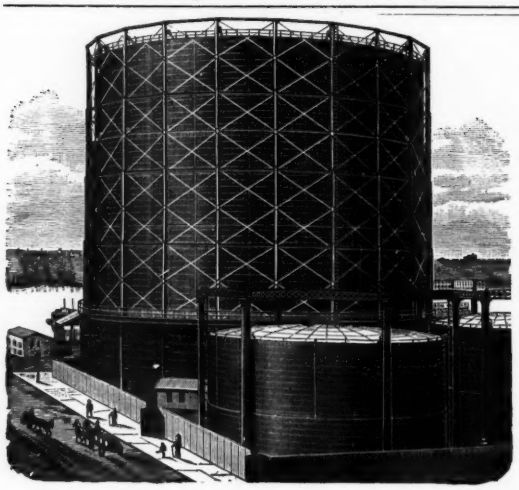

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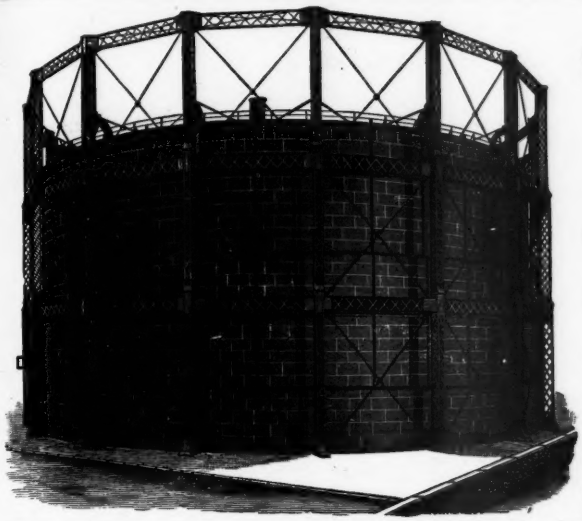

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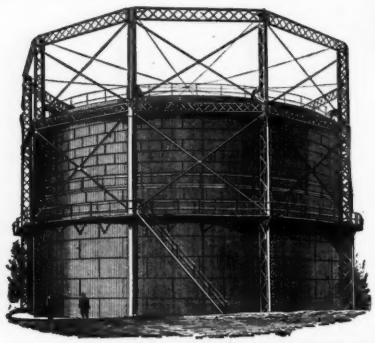

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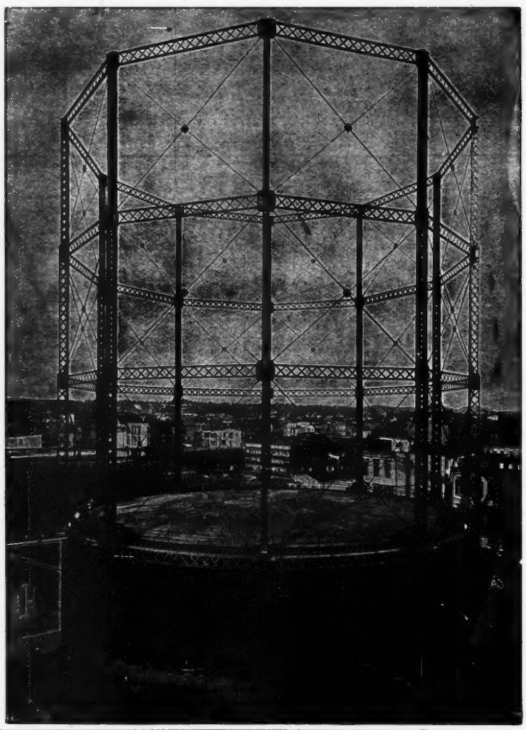

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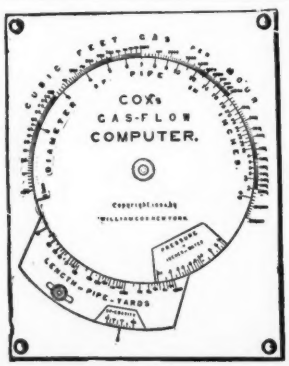

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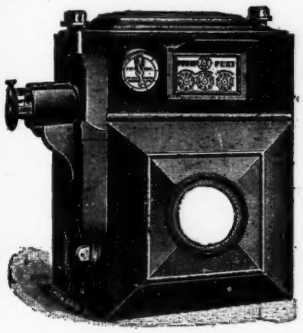

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